METROPOLITAN DISTRICT COMMISSION

SECOND ANNUAL REPORT

1921

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The Commonwealth of Massachusetts

ANNUAL REPORT

OF THE

METROPOLITAN DISTRICT COMMISSION

FOR THE YEAR 1921

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CONTENTS.

Report of the Metropolitan District Commission.

To the Honorable the Senate and House of Representatives of the Commonwealth of Massachusetts in General Court assembled.

The Metropolitan District Commissioner has already presented to your Honorable Body an abstract of the account of the receipts, expenditures, disbursements and liabilities of the Water and Sewerage Divisons for the fiscal year ending on November 30, 1921, and now presents a detailed statement of the doings of the Commission in the Parks Division for the fiscal year ending on November 30, 1921, and in the Water and Sewerage Divisions for the calendar year ending December 31, 1921.

SECOND ANNUAL REPORT.

I. ORGANIZATION AND ADMINISTRATION.

Commission, Officers and Employees.

The term of office of Ellerton P. Whitney expired on November 30, 1920, and George B. Wason was appointed for the term of five years next succeeding. The Commission consists of James A. Bailey, Commissioner, Frank A. Bayrd, Frank G. Hall, William H. Squire and George B. Wason, Associate Commissioners. Frank G. Hall is Director of Parks, John R. Rablin, Director of Park Engineering; William E. Foss, Director of the Water Division; and Frederick D. Smith, Director of the Sewerage Division.

All directors of divisions serve without extra compensation, receiving only the salaries attached to the other positions which they hold. A two years' trial of this method of selecting directors proves it to be efficient and economical. The chief engineers are the persons best fitted to head their respective divisions, and the associate commissioner has supervised his division skillfully and effectively. It seems unnecessary and unwise to create new salaried positions under the name of directors of divisions.

George Lyman Rogers has continued as secretary, Alfred F. Bridgman as purchasing agent, and the following as chief engineers: of parks, John R. Rablin; of water, William E. Foss; of sewerage, Frederick D. Smith.

Mary V. Habberley has continued as bookkeeper and financial secretary of the Parks Division, and Alice G. Mason as bookkeeper and May L. Powers as financial secretary of the Water and Sewerage Divisions.

Herbert W. West has continued as superintendent of the Revere Beach Division and Charles River Division, Lower Basin; Elmer E. Bickford as superintendent of Nantasket Beach Division; Bartholomew J. Costello as superintendent of Blue Hills Division; John L. Gilman as superintendent of Charles River Upper Division; Albert N. Habberley as superintendent of Middlesex Fells Division.

The organization of the Water and Sewerage Divisions is stated in detail in the accompanying reports of the directors of those divisions.

The maximum number of employees during the year was 1,586, divided as follows: general offices, 33; parks, 995; water, 370; sewerage, 188.

In this tabulation of employees the police are included under parks, although considerable protection of the Water System is given by the metropolitan district police.

Offices.

During the year the principal office of the Commission was continued in the Kimball Building, and the water and sewerage engineering, bookkeeping and clerical work was carried on at Nos. 1 and 3 Ashburton Place. As the lease of the rooms in the Kimball Building expired on December 31, 1921, and the future rental would be about $14,000 per year, the Commission determined to vacate these premises and consolidate all divisions under one roof at the Ashburton Place building, used for nearly a quarter century for metropolitan water and sewerage headquarters. This location is good, but the building is far from an ideal one for the purposes required, and it is again recommended that a suitable building be constructed to contain the administrative, engineering and clerical offices, and to safeguard the valuable plans and other property of the Commission.

II. GENERAL FINANCIAL STATEMENT.

Year ending November 30, 1921.

Expenditure for construction	$413,072 16
Expenditure for maintenance	2,654,201 46
Total expenditure	3,067,273 62
Unexpended balance maintenance appropriations	305,084 63
Serial bonds paid	181,555 25
Increase in sinking funds	2,155,277 88
Decrease in net debt	2,336,833 13

On November 30, 1921.

Net debt	$46,496,868 91

III. CONSTRUCTION.

In July the extension of the South Metropolitan Sewerage System to Wellesley, authorized by chapter 343 of the Acts of 1914, accepted by the town and begun in 1915, was completed and the town connected with the system. In December the Reading extension of the North Metropolitan Sewerage System, authorized by chapter 159 of the Acts of 1916 and begun in 1918, was also completed and the town connected. The cost of these extensions was very large, due in part to conditions growing out of the war and in part to natural difficulties of construction.

The principal work of construction in the Water System consisted of the completion of the southern extra high-service pipe line for Hyde Park and Milton, the installation of additional equipment at the Chestnut Hill pumping station, and the building of the foundation for the Arlington Reservoir.

In the Parks System the West Roxbury Parkway and the Dedham Parkway were completed, Cradock bridge in Medford was widened and improved, a sanitary building started at Riverside and the work of filling along Quincy Shore begun.

On the night of June 16 and the early morning of June 17, 1921, the wooden bridge over the Saugus River on the Lynnway Boulevard, under the control of the Metropolitan District Commission, was burned to the water's edge for a length of about 420 feet. A very important line of communication from Boston and its suburbs to Lynn, Swampscott, Salem and other portions of Essex County was thereby broken. No appropriation was available for the re-

construction of this bridge, and after a conference with the Governor it was voted to direct the chief engineer to prepare plans for a permanent bridge to cost not exceeding $150,000, and subscriptions were obtained from leading banks and bankers of Boston to the amount of $150,000 to pay the cost of constructing a permanent bridge, upon the understanding that the Governor would recommend to the Legislature of 1922 the repayment to the subscribers of the sums advanced by them.

Late in June a delegation from Essex County, headed by Mayor Creamer of Lynn and Henry S. Baldwin, chief engineer of the General Electric Company, met the Commission and urged the immediate construction of a temporary wooden bridge on account of the serious interference with travel caused by the destruction of a large portion of the old bridge. The fact that no funds of the Commonwealth were available for the work was called to the attention of this delegation, and Mayor Creamer promptly stated that he would undertake to obtain from the city council of Lynn an appropriation of the sum necessary to construct a temporary wooden bridge. It was understood that no contract could be made or promise given that the Commonwealth would reimburse the city of Lynn, but after a conference with the Governor, it was agreed that a recommendation would be made by him to the Legislature of 1922 that the city of Lynn be reimbursed for the sum expended for the construction of the temporary wooden bridge.

Rapid progress was made in the preparation of plans and the awarding of a contract for the furnishing of labor and equipment. The General Electric Company assisted in every way possible with its large and efficient organization, and work was started on the morning of July 5. Every effort was made by competent men to push the work as rapidly as possible and at moderate cost. At 11.15 A.M., July 18, the bridge was sufficiently completed to make it safe to allow traffic to pass over it, and the Commissioner, therefore, took over from Mayor Creamer of Lynn at that time the operation of the bridge, and it was opened to the public. A small amount of work remained to be done, and this was fully completed on July 28, 1921. Thus a bridge adequate for several years was constructed in record-breaking time, and the immediate need for a permanent fireproof bridge ceased.

On October 21, 1921, Mr. Henry S. Baldwin, chief engineer, submitted to the Commission a detailed statement of the rebuilding of the bridge, together with the figures of its actual cost. It appears from these figures that the cost of the work, including insurance against fire for a period of six months, was $37,853.15.

IV. THE NOVEMBER STORM.

In the last days of November the Middlesex Fells Reservation, in common with a large region north and west of Boston, was visited by the most destructive storm of rain, sleet and snow recorded in the history of Massachusetts. For many hours the temperature remained at or near the freezing point, while a fairly constant precipitation of moisture in various forms added to the weight of accumulated ice on the branches and tops of trees and shrubs. During this period, as the wind arose there was an almost continuous cracking and breaking of limb after limb and tree after tree. When the sun finally melted the masses of ice and the surviving trees were released from their bondage, a scene of devastation, almost unparalleled, was revealed. Of thousands of trees only broken stumps remained, and of tens of thousands the tops or limbs had been stripped, so that the appearance of the woodland was not unlike some of the forests of France raked for weeks by the fire of cannon. All varieties of deciduous trees suffered total or partial destruction, but the pines and other coniferæ were damaged only slightly.

It is estimated that an expenditure of $50,000 will be required to clear the ground in the Fells of broken branches and the stumps of ruined trees, and a larger sum will be needed to cut the broken tops and limbs and perform the necessary tree surgery. A generation will pass before the results of this disastrous storm will disappear from view.

In addition to the Fells, many acres of woodland under the control of the Commission in other localities suffered similar damage, but fortunately the Blue Hills Reservation escaped damage and destruction, as the temperature there was slightly higher than in most other parts of the Metropolitan District, and ice did not accumulate on the trees in sufficient quantity to break them down.

V. CHARLES RIVER BRIDGES.

Chapter 497, Acts of 1921, authorized and directed the Commission to remove four existing bridges over the Charles River, at Arsenal Street, Western Avenue, River Street and Cottage Farm, and to construct new bridges with suitable approaches at or near their respective sites at a cost not to exceed $1,475,000.

After the act was passed it was discovered that it was defective in so far as it dealt with the three upper bridges, for the reason that it did not comply with an act of Congress approved February 27, 1911, which required the State, before the construction of said bridges or any of them is begun, to provide by legislative enactment for compensation for certain damages and for the appointment of commissioners by the Supreme Judicial Court to hear the parties in interest and assess damages.

Conferences with officials of the Commonwealth and of Boston and Cambridge resulted in a general agreement that it was best to submit the entire matter to the Legislature for further action before beginning the construction of any of the four bridges.

In order to have the benefit of the advice of a small committee made up of men of technical skill and artistic ability, to the end that the bridges may be a fitting expression of the best taste of the community, a request was made to the respective presidents of Harvard College, Massachusetts Institute of Technology, Boston Society of Civil Engineers and Boston Society of Architects, each to designate a man to serve on an advisory committee. This request was promptly honored and the following were named: Prof. George F. Swain, Prof. Charles M. Spofford, Mr. Leonard Metcalf and Mr. William D. Austin.

This committee made a careful study of the problem and reported in writing their conclusions, as follows: —

(A) That the Cottage Farm bridge "should not be rebuilt on its present site, but that the new bridge should be in the line between Magazine Street, Cambridge, and St. Paul Street on the Boston side."

"Our reasons for arriving at the above conclusion that the site should be changed are —

(1) We have had counts taken of the traffic over the present bridge, including observations as to the direction of this traffic before and after crossing the bridge, and we believe that the traffic would be better accommodated, and that the approaches would be better, if the bridge were on the suggested site.

(2) The suggested site would connect through thoroughfares on both sides of the river, and would afford a continuous thoroughfare between Central Square in Cambridge, and Brookline Village.

(3) Our studies and estimates have led us to the conclusion that a suitable bridge on the new site could be built within the appropriation, and that it would cost little, if any, more than if the new bridge were built on the present site. The cost of a temporary bridge would be saved, for the present bridge could be used as a temporary bridge during the construction of the new bridge; also, there would be less interference with railroad operation on the new site and less expense due to this cause.

(4) The character of the river bed, as shown by borings, indicates that it is practically the same as on the present site.

(5) The new bridge is to be a permanent one, and should be a worthy and handsome part of the park improvements. We believe that its appearance will be much better on the new site than on the present site, where it is disfigured by the proximity of the railroad bridge which adjoins and passes beneath it."

(B) That the Western Avenue bridge and the River Street bridge "are only about 1,000 feet apart, and the traffic over them is so small that a single bridge would suffice. We believe that there never was a time when it was as important as at present to practice economy, — personal, municipal or State. We are therefore unanimously of the opinion that only the Western Avenue bridge should be rebuilt, and that when the River Street bridge is no longer able to carry traffic safely it should be discontinued, and a traffic street built on the western side of the river between Cambridge Street and Western Avenue, over which traffic could be diverted. This street could be built on land now owned by your Commission. The saving of the interest on the cost of a new bridge at River Street would pay for the cost of this new street in a very few years."

As the conclusions of the advisory committee were adopted unanimously by the Commission and approved by officials of the cities chiefly interested, the Legislature will be asked at the session of 1922 to modify the former act in accordance with the recommendations of the advisory committee and the requirements of Federal law.

This report would be incomplete did it not record deep appreciation of the public spirit which actuated the members of this committee in making a painstaking investigation and giving valuable expert advice without reward other than the sense of a service to the Commonwealth well performed.

VI. RAINFALL AND CONSUMPTION OF WATER.

The rainfall on the watersheds of the metropolitan system and the yield therefrom for the year were about normal. Early in April all the reservoirs were full and water was wasted continuously until June. During the year no water was drawn for consumption from Framingham reservoirs Nos. 1 and 2, Ashland, Hopkinton and Whitehall reservoirs and Lake Cochituate, which together have a daily dry-weather capacity of about 40,000,000 gallons, a supply sufficient at 100 gallons per day per person for 400,000 people. At the end of the year the Wachusett Reservoir was 6.79 feet below high-water mark, — a normal point for that season.

The per capita consumption of water was reduced during the year to an average daily rate of 95 gallons. Principally on account of the gradual installation of meters, required by chapter 524 of the Acts of 1907, the total amount of water consumed in the District in recent years is not materially greater than in the years following the first filling of the Wachusett Reservoir in 1908.

The total amounts of water supplied to the Metropolitan Water District, in million gallons, for two years at the beginning and two years at the end of the fourteen-year period, are as follows: —

1908	45,911	1920	46,579
1909	43,478	1921	42,853

Thus a considerable increase in population has been offset for more than a decade by metering and otherwise; and it will be of interest to observe the effect in the future of the gradual metering of the services which are at present unmetered, and which number more than 40,000, or about 25 per cent of all services.

VII. THE SPOT POND CASE.

Chapter 488, Acts of 1895, which provided for a metropolitan water supply, authorized the taking *inter alia* of "Spot Pond, so called, in or near the town of Stoneham, and the lands under and surrounding the same, now owned by the cities of Malden and Medford and the town of Melrose, or either of them, held for the purpose of water supply or of protecting or preserving the purity of the water, and the pumping stations and pumps thereon." A taking of the said pond, lands, etc., was duly made by the Metropolitan

Water Board on January 1, 1898, and after costly litigation Malden, Medford and Melrose were awarded and paid a sum in excess of $1,100,000. The rights of all parties to file petitions for the assessment of damages expired two years after the date of taking. Stoneham made no claim of ownership of Spot Pond or damages for the taking within this period.

Fourteen years after the taking, chapter 689, Acts of 1912, provided that Stoneham might file a petition for damages within one year, and a petition was duly filed. In 1921, twenty-three years after the taking, the petition was heard before three commissioners, who made various findings of fact and rulings of law, and concluded as follows: —

> We, the commissioners, find that the petitioner suffered no damage; but in the alternative, however, that if, as a matter of law on the acts, votes, facts and findings hereinbefore set out, the petitioner on January 1, 1898, the date of the taking, had the right to take water for the use of its inhabitants from said Spot Pond, then we find for the petitioner and assess the damages at $188,000, with interest from January 1, 1898.

The cost of the hearing to the Metropolitan Water District exceeded $25,000, and if the Court does not accept the determination and the ultimate finding is in the alternative, the sum of $188,000 with interest, or a total of more than $400,000, will be required to be paid for Spot Pond in addition to more than $1,100,000 paid for the same pond two decades ago.

VIII. FUNCTIONS OF METROPOLITAN DISTRICT COMMISSION.

The Metropolitan District Commission is a natural evolution from three separate metropolitan commissions of earlier years. When the Metropolitan Sewerage Commission was created in 1889 it seemed self-evident that the sewage disposal problem of Boston and the surrounding cities and towns could be handled better in one or two units than in eighteen units. Yet a strong contest against the constitutionality of the act was made in the courts, largely because of the novelty of the experiment of creating new units or districts. To-day no one doubts the wisdom of the experiment, and no one questions that the metropolitan sewers, pumping stations and outfalls have been built and operated wisely and economically.

The Metropolitan Parks Act of 1893 marks the next step in the development of the idea of a metropolitan Boston. The accomplishment of the Metropolitan Park Commission in obtaining and preserving the Blue Hills, Middlesex Fells, Revere Beach, Nantasket Beach, Charles River Basin and other important reservations, and in linking them together with adequate parkways and boulevards, is known of all men. In the important matters of a wise provision for outdoor recreation and the preservation of forest, shore and river front, Boston and its neighbors are in effect a single community.

The Metropolitan Water Act of 1895 carried still further the idea of a Boston metropolitan district, and the business enterprise of supplying water at cost to Boston and the near-by towns and cities has been an unqualified success. An abundant supply of pure water is obtained by all the inhabitants of the District, and in no case is the cost of the water to the consumer greater than in the old days of local individual sources of supply, and in many cases it is far less.

In 1901 the Metropolitan Sewerage System being largely completed, the Sewerage Commission and the Water Board were consolidated, and in 1919 there was a further consolidation of the Water and Sewerage Board and the Park Commission into the Metropolitan District Commission.

It seems probable that the growth and evolution of the Metropolitan District in a third of a century point to a greater growth and further evolution in the years to come. The common interest of all the people of the entire district in water supply, sewage disposal, reservations and boulevards is not unlike their common interest in policing, fire fighting, schooling and other public matters. Boston and its suburbs are already one in most respects. If the heart is impaired the remoter parts of the body suffer, and without the support of those remoter parts the heart will itself suffer. In the further gradual development of the metropolitan district idea may be found the best hope for the future of Boston and those cities and towns tributary to Boston and dependent for their welfare upon its prosperity.

It seems, therefore, that the metropolitan district conception ought not to be weakened or the functions of the board which is carrying on the work and the traditions of the earlier commissions lessened or impaired. The Metropolitan District is unlike a department of the State government. It is a local unit or group of cities

and towns lawfully banded together for the better administration of the important functions of creating one water supply from which each may obtain water, two sewage disposal systems jointly administered through which each may dispose of its sewage, and one system of reservations and parkways to be enjoyed by the inhabitants of all.

The cities and towns in the respective metropolitan districts are the real owners of the water, sewerage and park properties, and the Commonwealth, for convenience of administration and because it has lent its credit, holds the legal title and exercises certain supervision. The municipalities pay the bills in proportions fixed by law, and naturally desire to retain some measure of local self-government in relation to the important functions now entrusted to the District Commission. That State departments, with state-wide activities, made up in whole or in large part of non-residents of the Metropolitan District ought to administer the local affairs of Boston and its suburbs seems contrary alike to the dictates of common sense and experience.

IX. OTHER REPORTS.

The reports of the Directors of Parks, Park Engineering, Water and Sewerage, with the usual tables, statistics and financial statements, are herewith presented.

Respectfully submitted,

JAMES A. BAILEY,
Metropolitan District Commissioner.

Boston, February 26, 1922.

REPORT OF THE DIRECTOR OF PARKS.

Hon. James A. Bailey, *Commissioner, Metropolitan District Commission.*

Dear Sir: — I submit herewith my first annual report as Director of Parks of the Metropolitan District Commission.

Few people realize the extent and variety of the work involved in the maintenance of the Metropolitan Park System and the impossibility of noting, in the small compass of a report like this, all the interesting or important details of administration. The parks and boulevards are scattered through the thirty-eight cities and towns of Boston and vicinity, that is, through an area of over 400 square miles. The parks themselves have an aggregate area of 14 square miles. The parks and boulevards also include about 106 miles of carriage roads, 63 of which are much traveled automobile roads; 6 beaches, with a total water frontage of 13 miles; more than 53 miles of the river banks of the Charles, Mystic and Neponset; 4 large public bath-houses; the Charles River and Cradock bridge dams and locks; and the Boston and Cambridge embankments. This bare outline of the field of work readily suggests the multiplicity of details of maintenance and the impossibility of making more than a cursory review of the more important accomplishments of the year. Even this is not so simple a task as would appear on its face, because no feature of the administrative work of the Parks Division, however great, is worth recording merely because it has been done, but because it has made the park system more available to the public for exercise and recreation and has promoted public use and enjoyment. To accomplish this involves not only the supply, where needed, of pure drinking water, which is the sole problem of the Water Division, or the provision of sanitary accommodations, where needed, which is similar to the problem of the Sewerage Division, but the furnishing of these and all other reasonable facilities tending to increase public enjoyment and use of the natural beauties and advantages of the reservations. The problem of maintenance of the parks system is one of how best to promote and arouse interest in

healthy, outdoor enjoyment. It cannot be properly solved without an appeal to the human equation, — constant study and anticipation of the wants and desires of the public. I have confined the following report, therefore, to such features as seem to me may be fairly said to be conducive to this general purpose.

By chapter 509 of the Acts of 1920 the Cambridge park lands were transferred last December to the care of this Commission, and the name "Cambridge Parkway" was adopted for the lands thus transferred. Since then much has been done to improve the roads, walks, gutters, curbing and general appearance, and it is hoped in another twelve months to bring the parkway up to the same high standard as the rest of the parkways. The bath house at Magazine Beach did very well, becoming practically self-supporting for the first time in its history. On some days over 1,000 bathers took advantage of its accommodations. A sanitary is much needed there, and funds to build one have been asked for in the budget estimates.

During the spring the Charles River Speedway was resurfaced, and it is believed that the Speedway is not surpassed now by any in the country. A great many people attend the Saturday races there.

On the east bank of Charles River filling is going on, and it is hoped to have the road along the river from North Harvard Street to Cottage Farm opened for travel, with a view to completing at the earliest possible moment the driveway link connecting with Bay State Road, making another artery for travel to the west, and relieving congestion on Commonwealth Avenue.

A new sanitary building is now under construction at Riverside, near Weston bridge, which will be of great benefit to the public, and a much-needed improvement.

The Riverside Recreation Grounds have given their share of healthy outdoor entertainment to our people, both young and old, and it is the purpose of the Commission to have the road leading from the grounds to East Newton Street in better condition the coming spring.

In the vicinity of Echo bridge, the most picturesque bridge of the Parks District, some sort of a rest and sanitary building is sadly needed. The present accommodations are most primitive. I recommend the construction of such a suitable rest and sanitary building at that place.

The work of filling along Quincy Shore Drive, from Appleton Street to Fenno Street, is being started for the protection of the roadway and with the idea of widening this much-used road which now is too narrow to accommodate the many people who visit the reservation in automobiles on summer evenings.

West Roxbury Parkway and the new bridge over the New York, New Haven & Hartford Railroad, from Belgrade Avenue to Centre Street, have been completed, and are much used by automobilists in going to the south of Boston. The automobilists are using Blue Hills Reservation more than ever, and with Furnace Brook Parkway now in fine shape to Adams Street, West Roxbury Parkway completed and Dedham Parkway opened to travel, the public is provided with a much-needed drive from the towns south of Boston to the South Shore. I recommend that still another outlet for automobiles be made toward Braintree from Houghton's Pond along the southerly border of the reservation.

Bids for the construction of Neponset bridge have been advertised for from time to time, but thus far the bids have been in excess of the appropriation available for the purpose. I hope the Legislature will provide enough additional appropriation to enable the construction of a proper permanent structure. A bill requesting an additional appropriation will be presented to the Legislature of 1922.

The need of a suitable connection between Boston and the Metropolitan Park System on the north has been obvious, and investigations and favorable reports have been made by various commissions and organizations in the last twenty years. This necessity grows more imperative every year. Such a highway might well be constructed for both general and pleasure traffic, and it seems to me that, so far as the cost would be incurred in providing for general traffic purposes, a part might well be paid from money received by the Commonwealth for motor vehicle registration and license fees, and also that an allotment might be made from the Federal aid to roads in this Commonwealth.

Middlesex Fells Division is receiving larger patronage. The Commission has improved the facilities for parking at the Stoneham headquarters, where many hundreds visit the collection of animals and birds. I believe this collection should be enlarged and improved when possible. At the northerly end of Spot Pond a large lot of land has been set aside for automobile parking, and is being taken

advantage of. I think there should be a road opened to automobile travel from Spot Pond or Forest Street, connecting with Mystic Valley Parkway in Winchester. This would give a large number of people easy access to the reservation who now have to travel around Bear Hill or to the south on Border Road, which has been opened to automobile traffic with success.

Chapter 398 of the Acts of 1921 required the Commission to reconstruct, widen and improve Cradock bridge over the Mystic River in Medford. The work is practically completed.

The gypsy-moth situation is well in hand, and the elms and other hardwood trees are doing better. The planting of trees, which has been practically at a standstill for the last few years, except for 200,000 white pine seedlings which have been planted in Blue Hills Reservation, is starting again, and I am greatly in favor of doing much of it. The cutting of the dying chestnut trees in Blue Hills Reservation is almost completed, and the white pines, which now are well started, will soon improve the appearance of the reservation. I think, however, that the question of varying somewhat the kinds of trees planted might well be given serious study. I would recommend also that, in order to provide food for the wild animals and birds in the reservations, more planting be done of berry-bearing shrubs and nut-bearing trees.

During the summer, permission was granted to the Appalachian Mountain Club to use land near Ponkapoag Pond for the erection of a camp, which I consider a wise idea. The club does, and has done, much to stimulate love of outdoor life, which is so essential to the physical and mental well-being of the people, and to secure which the Park System was created. In this connection it seems most appropriate to recall the fact that to the Appalachian Mountain Club is due the credit of starting the movement which ultimately ripened into the Metropolitan Park System. In 1890 the club called a meeting of persons interested in the "preservation of scenery and historical sites in Massachusetts." The invitation to the meeting called attention to the fact that opportunities for beholding the beauty of nature are of great importance to the health and happiness of crowded populations; that these opportunities were rapidly vanishing in Massachusetts; that many remarkable scenes near Boston had been despoiled of their beauty; that this was likely to happen throughout the State; and that, unless some steps toward

preservation of those natural advantages were taken quickly, the opportunity for action was past. The meeting thus called resulted in the appointment of a committee to draft a petition to the Legislature for legislation which finally became the act of 1891 incorporating the Trustees of Public Reservations. Almost immediately the Trustees of Public Reservations took up with the Park Commissioners and committees of the Metropolitan District about Boston the subject of legislation to preserve the scenes of natural beauty and of public interest in and around Boston, and as a result a petition was drafted to the Legislature asking for prompt action in this direction. This petition resulted in the creation, in 1892, of a commission to study the question, and in 1893 the creation of the Metropolitan Park Commission to lay out, acquire and maintain ample open spaces for the use of the public in the towns and cities in the vicinity of Boston.

Upon petition of Representative William D. Lancaster, a ball field was laid out in Dorchester Lower Mills, Neponset River Reservation, which has been enjoyed by several thousands of people.

Charles River Basin and the beautiful walks of the Boston embankment have been used more than ever before. Throngs of people enjoy trips in the numerous boats licensed by the Commission to take on and land passengers at the floats on the basin.

The band concerts during the summer attracted large numbers, and many compliments in regard to the fine quality of the music have been received. The concerts are especially appreciated at Nantasket. The hotel and other privileges there were well patronized. A garage and building for storage of wagons and tools is being erected on the westerly side of Nantasket Avenue, northerly from the police station. Some form of shelter for people caught in the rain and waiting for transportation, and a men's sanitary are greatly needed at the junction of Nantasket Avenue and Wharf Avenue, so called, and I recommend that such be provided as soon as possible.

Alterations and repairs have been made in the fence surrounding the Bunker Hill Monument grounds, which have now been put in a condition appropriate to furnish a setting for the most historic and significant monument in America. Over 35,000 people visited and ascended the monument during the year. Such an appropriation

should be made each year for the care of this monument and the grounds as will make it possible to eliminate any signs of neglect.

The bath-houses at Revere, Nantasket and Nahant beaches are deteriorating every year. They are open structures of wood and should be rebuilt of more lasting material as soon as possible.

By chapter 397 of the Acts of 1921 the sum of $225,000 was appropriated for completing the extension of Winthrop Parkway to the Winthrop line. Bids were obtained this fall for this construction along the shore, but the bids proved too high to allow both construction and purchase of the necessary additional land. I recommend that an additional appropriation be asked for sufficient to complete this parkway along the shore route, which seems to be the only feasible one for straight parkway purposes under the parkway act.

Many expressions of satisfaction have been received from time to time in regard to the change in color of paint for fences, vehicles, etc., from dark brown to the gray used in other State departments. This is a great saving because the mixing is done by the reservation forces, and the paint is bought in large quantities. The high board fences, formerly painted dark brown, are being done away with, and cement posts with solid gray planks are being substituted where needed. This is an improvement in appearance and cost.

We are now policing Chestnut Hill Reservoir with metropolitan district police successfully, but the city of Boston, which controls the surrounding roads, does not keep them up to the standard of the park roads, and consequently the roads are not used as they should be.

Our police department is doing excellent work, and the officers and men are to be congratulated on the way in which they have handled their many difficult problems. The Department is now nineteen men less than last year, made possible partly by the greater use of motorcycles and automobiles, which enables the officers to cover much greater territory than when on foot or on horseback. The police department has more work than at any other time, with the additional work made necessary by the taking over of the Cambridge Parkway lands, policing Chestnut Hill Reservoirs, the yearly increasing traffic, and the greatly increased trouble caused by intoxicated persons in automobiles since the prohibition amendment went into effect. It is the desire of the Commission to still further

reduce the number of officers on horseback and increase the number on motorcycles. At Revere, Charles River Division, Lower Basin, and the Speedway the police horses have been done away with, and it is hoped to dispense with most of them in Blue Hills and Middlesex Fells. It has been found that one motorcycle officer is equal to two on horseback, and much more economical.

The attendance at the bath-houses has been excellent, and the conduct of the bathers has been much improved by the valuable co-operation of the two experienced policewomen with the rest of the force.

The lighting of most of the park roads is very poor, owing to the difficulty of obtaining electricity for the purpose. A special report of the subject was made to the Legislature of 1921, and estimates furnished for installation of electric lighting. It is hoped that this work, or a beginning on it, will be authorized by the next Legislature.

In order that the public may keep in mind the facilities for outdoor exercise and enjoyment offered by the Parks System, and of such improvements as are made from time to time, I would recommend that some method be devised of conveying to the press items of information on this subject and news of new improvements and developments. I think this is perfectly feasible without any additional expense.

Respectfully submitted,

FRANK G. HALL,
Director of Parks.

December 1, 1921.

Metropolitan Park System—Dec. 1, 1921.

	Reservations (Acres).															
	Bunker Hill.	Blue Hills.	Middlesex Fells.	Stony Brook.	Beaver Brook.	Hart's Hill.	Hemlock Gorge.	Charles River.	Mystic River.	Neponset River.	King's Beach and Lynn Shore.	Revere Beach.	Winthrop Shore.	Quincy Shore.	Nantasket Beach.	Total Acres.
Cities.																
1 Boston,	6.05	-	-	463.72	-	-	-	177.56	-	146.89	-	-	-	-	-	794.22
2 Cambridge,	-	-	-	-	-	-	-	134.66	-	-	-	-	-	-	-	134.66
3 Chelsea,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4 Everett,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5 Lynn,	-	-	-	-	-	-	-	-	-	-	19.59	-	-	-	-	10.59
6 Malden,	-	-	59.53	-	-	-	-	-	-	-	-	-	-	-	-	59.53
7 Medford,	-	-	664.17	-	-	-	-	-	42.37	-	-	-	-	-	-	700.54
8 Melrose,	-	-	177.54	-	-	-	-	-	-	-	-	-	-	-	-	177.54
9 Newton,	-	-	-	-	-	-	4.24	186.25	-	-	-	-	-	-	-	190.49
10 Quincy,	-	2,562.57	-	-	-	-	-	-	-	-	-	-	-	32.91	-	2,595.48
11 Revere,	-	-	-	-	-	-	-	-	-	-	-	64.99	-	-	-	64.99
12 Somerville,	-	-	-	-	-	-	-	-	4.03	-	-	-	-	-	-	4.03
13 Waltham,	-	-	-	-	42.77	-	-	38.68	-	-	-	-	-	-	-	81.45
14 Woburn,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Towns.																
15 Arlington,	-	-	-	-	-	-	-	-	7 83	-	-	-	-	-	-	7.83
16 Belmont,	-	-	-	-	15.56	-	-	-	-	-	-	-	-	-	-	15.56
17 Braintree,	-	67.84	-	-	-	-	-	-	-	-	-	-	-	-	-	67.84
18 Brookline,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19 Canton,	-	471.34	-	-	-	-	-	-	-	264.26	-	-	-	-	-	735.60
20 Cohasset,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21 Dedham,	-	-	-	-	-	-	-	-	-	234.54	-	-	-	-	-	234.54
22 Dover,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23 Hingham,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24 Hull,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25.59	25.59
25 Milton,	-	1,547.68	-	-	-	-	-	-	-	270.33	-	-	-	-	-	1,818.01
26 Nahant,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27 Needham,	-	-	-	-	-	-	14.24	-	-	-	-	-	-	-	-	14.24
[Randolph],	-	257.00	-	-	-	-	-	-	-	-	-	-	-	-	-	257.00
28 Saugus,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29 Stoneham,	-	-	582.60	-	-	-	-	-	-	-	-	-	-	-	-	682.60
30 Swampscott,	-	-	-	-	-	-	-	-	-	-	3.10	-	-	-	-	3.10
31 Wakefield,	-	-	-	-	-	22.97	-	-	-	-	-	-	-	-	-	22.97
32 Watertown,	-	-	-	-	-	-	-	79.17	-	-	-	-	-	-	-	79.17
33 Wellesley,	-	-	-	-	-	-	4.58	66.07	-	-	-	-	-	-	-	70.65
34 Weston,	-	-	-	-	-	-	-	117.94	-	-	-	-	-	-	-	117.94
35 Westwood,	-	-	-	-	-	-	-	-	-	6.57	-	-	-	-	-	6.57
36 Weymouth,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
37 Winchester,	-	-	261.93	-	-	-	-	-	-	-	-	-	-	-	-	261.03
38 Winthrop,	-	-	-	-	-	-	-	-	-	-	-	-	16.83	-	-	16.83
	6.05	4,906.43	1,845.77	463.72	58.33	22.97	23.06	800.33	54 23	922.59	22.69	64.99	16.83	32.91	25.59	9,260.49

	Parkways (Acres).																			
	Blue Hills.	Woburn.	Middlesex Fells.	Revere Beach.	Mystic Valley.	West Roxbury.	Neponset River.	Fresh Pond.	Lynn Fells.	Furnace Brook.	Nahant Beach.	Hammond Pond.	Old Colony.	Quannapowitt.	Lynnway.	Winthrop.	Dedham.	Alewife Brook.	Total Acres.	Grand Total Reservations and Parkways (Acres).
Cities.																				
1 Boston,	.27	-	-	-	-	72.37	22.76	-	-	-	-	-	50.71	-	-	-	21.98	-	170.11	964.33
2 Cambridge,	-	-	-	-	-	-	-	12.40	-	-	-	-	-	-	-	-	-	86.38	98.78	142.62
3 Chelsea,	-	-	-	21.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21.21	21.21
4 Everett,	-	-	-	31.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31.26	31.26
5 Lynn,	-	-	-	-	-	-	-	-	-	-	.32	-	-	-	-	-	-	-	.32	19.91
6 Malden,	-	-	23.58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23.58	83.11
7 Medford,	-	-	44.56	8.10	265.34	-	-	-	-	-	-	-	-	-	-	-	-	-	318.00	1,024.54
8 Melrose,	-	-	-	-	-	-	-	-	7.57	-	-	-	-	-	-	-	-	-	7.57	185.11
9 Newton,	-	-	-	-	-	-	-	-	-	-	-	114.50	-	-	-	-	-	-	114.50	304.99
10 Quincy,	-	-	-	-	-	-	-	-	-	101.25	-	-	2.47	-	-	-	-	-	103.72	2,699.20
11 Revere,	-	-	-	06.31	-	-	-	-	-	-	-	-	-	-	5.15	7.01	-	-	79.37	144.36
12 Somerville,	-	-	13.08	-	4.95	-	-	-	-	-	-	-	-	-	-	-	-	9.97	28.90	32.93
13 Waltham,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	81.45
14 Woburn,	-	22.54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22.64	22.64
Towns.																				
15 Arlington,	-	-	-	-	17.40	-	-	-	-	-	-	-	-	-	-	-	-	28.10	45.50	53.33
16 Belmont,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20.43	20.43	35.99
17 Braintree,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	67.64
18 Brookline,	-	-	-	-	-	-	-	-	-	-	-	69.19	-	-	-	-	-	-	69.19	69.19
19 Canton,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	735.60
20 Cohasset,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21 Dedham,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15.16	-	15.16	249.70
22 Dover,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23 Hingham,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24 Hull,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25.59
25 Milton,	83.31	-	-	-	-	-	51.35	-	-	-	-	-	-	-	-	-	-	-	134.60	1,952.67
26 Nahant,	-	-	-	-	-	-	-	-	-	-	81.66	-	-	-	-	-	-	-	81.66	81.66
27 Needham,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14.24
[Randolph],	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	257.00
28 Saugus,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29 Stoneham,	-	-	-	-	-	-	-	-	.15	-	-	-	-	-	-	-	-	-	.15	682.75
30 Swampscott,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.10
31 Wakefield,	-	-	-	-	-	-	-	-	-	-	-	-	-	13.47	-	-	-	-	13.47	36.44
32 Watertown,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	79.17
33 Wellesley,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	70.65
34 Weston,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	117.94
35 Westwood,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.57
36 Weymouth,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
37 Winchester,	-	.60	-	-	50.20	-	-	-	-	-	-	-	-	-	-	-	-	-	50.80	312.73
38 Winthrop,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.13	-	-	.13	16.96
	83.58	23.24	82.12	126.88	337.89	72.37	74.11	12.40	7.72	101.25	81.98	183.69	53.18	13.47	5.15	8.04	37.14	144.83	1,449.09	10,715.58

	Parkways (Miles).																			
	Blue Hills.	Woburn.	Middlesex Fells.	Revere Beach.	Mystic Valley.	West Roxbury.	Neponset River.	Fresh Pond.	Lynn Fells.	Furnace Brook.	Nahant Beach.	Hammond Pond.	Old Colony.	Quannapowitt.	Lynnway.	Winthrop.	Dedham.	Alewife Brook.	Total Miles.	
Cities.																				
1 Boston,	.015	-	-	-	-	1.510	.72	-	-	-	-	-	2.70	-	-	-	.49	-	5.435	1
2 Cambridge,	-	-	-	-	-	-	-	.520	-	-	-	-	-	-	-	-	-	1.563	2.083	2
3 Chelsea,	-	-	-	.814	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.814	3
4 Everett,	-	-	-	1.662	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.662	4
5 Lynn,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.120	-	-	-	.120	5
6 Malden,	-	-	1.515	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.515	6
7 Medford,	-	-	2.850	.482	4.45	-	-	-	-	-	-	-	-	-	-	-	-	-	7.782	7
8 Melrose,	-	-	-	-	-	-	-	-	1.060	-	-	-	-	-	-	-	-	-	1.060	8
9 Newton,	-	-	-	-	-	-	-	-	-	-	-	1.20	-	-	-	-	-	-	1.200	9
10 Quincy,	-	-	-	-	-	-	-	-	-	4.320	-	-	.36	-	-	-	-	-	4.680	10
11 Revere,	-	-	-	2.295	-	-	-	-	-	-	-	-	-	-	.570	.88	-	-	3.745	11
12 Somerville,	-	-	.740	-	.38	-	-	-	-	-	-	-	-	-	-	-	-	.303	1.423	12
13 Waltham,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
14 Woburn,	-	1.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.310	14
Towns.																				
15 Arlington,	-	-	-	-	1.40	-	-	-	-	-	-	-	-	-	-	-	-	.848	2.248	15
16 Belmont,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.473	.473	16
17 Braintree,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17
18 Brookline,	-	-	-	-	-	-	-	-	-	-	-	.80	-	-	-	-	-	-	.800	18
19 Canton,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19
20 Cohasset,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20
21 Dedham,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.49	-	.460	21
22 Dover,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22
23 Hingham,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23
24 Hull,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24
25 Milton,	2.250	-	-	-	-	-	1.540	-	-	-	-	-	-	-	-	-	-	-	3.790	25
26 Nahant,	-	-	-	-	-	-	-	-	-	-	2.230	-	-	-	-	-	-	-	2.230	26
27 Needham,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27
[Randolph],	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
28 Saugus,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28
29 Stoneham,	-	-	-	-	-	-	-	-	.060	-	-	-	-	-	-	-	-	-	.060	29
30 Swampscott,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30
31 Wakefield,	-	-	-	-	-	-	-	-	-	-	-	-	-	.774	-	-	-	-	.774	31
32 Watertown,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32
33 Wellesley,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33
34 Weston,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34
35 Westwood,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	35
36 Weymouth,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36
37 Winchester,	-	.07	-	-	1.780	-	-	-	-	-	-	-	-	-	-	-	-	-	1.850	37
38 Winthrop,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.02	-	-	.020	38
	2.265	1.38	5.105	5.253	8.01	1.510	2.260	.520	1.120	4.320	2.230	2.00	3.06	.774	.690	.90	.98	3.187	45.564	

REPORT OF THE DIRECTOR OF PARK ENGINEERING.

Hon. James A. Bailey, *Commissioner, Metropolitan District Commission.*

Sir: — I respectfully submit the following report of the work done under the supervision and direction of the engineering department of the Park Division for the year ending November 30, 1921.

The organization of the engineering department has been maintained substantially the same as in the past four or five years, with about the same minimum number (15) and slightly less maximum number (19) of employees. Engineering services have been furnished for all construction and maintenance work of the Park Division, including preliminary surveys, studies, designs and estimates, construction plans and specifications, and supervision and inspection; investigation and reports on all requests for permits by cities, towns, corporations, etc., for work in the reservations and parkways, the issue of permits when authorized and the supervision of the work done thereunder; the care, repair and operation of bridges, locks, tide gates and sluice gates.

The cost of conducting the department has been as follows: —

Engineering:		
Construction:		
Services	$10,554 10	
Expenses	2,757 57	
		$13,311 67
Maintenance:		
Services	$24,265 47	
Expenses	2,315 13	
		26,580 60
Total		$39,892 27

The following is a detailed list of the work done under the direction of the engineering department.

Parkways.

Blue Hills Parkway.

The section of the westerly roadway of Blue Hills Parkway from Mattapan bridge to Eliot Street has been resurfaced with bituminous concrete pavement. The work was done by the Rowe Contracting Company, lowest bidder. Work was begun on June 9, 1921, and completed on June 30, 1921. The total cost was $7,242.71. Area resurfaced, 3,274 square yards.

A section of the westerly or heavy traffic roadway of Blue Hills Parkway, near Canton Avenue, has been resurfaced with bituminous concrete pavement. The work was done by Mace Moulton, Jr., was begun July 25, 1921, and completed on August 5, 1921. The total cost was $5,979.51. Area resurfaced, 3,228 square yards.

Dedham Parkway.

The work of grading and surfacing Dedham Parkway from Stony Brook Reservation to East Dedham has been completed. The work has been done by the forces of the Blue Hills Division under Superintendent Costello. The parkway was opened to public travel on September 10, 1921.

Furnace Brook Parkway.

Work has been done and is now in progress by the forces of the division in cleaning, widening and deepening the channel of Furnace Brook, where it passes over land under care and control of this Commission. This work is being done in conjunction with similar work by the city of Quincy for the purpose of preventing the flooding of the lowlands bordering the brook, during times of heavy rainfall. The city is also rebuilding Newport Avenue culvert, which has been one of the chief obstructions to the free flow of the brook.

Lynnway.

On June 17, 1921, the northerly half of Saugus River bridge, from the drawbridge to a point about 200 feet from Lynn abutment, was burned. The plans and specifications were prepared for reconstruction of the burned portion in a permanent form, with stone masonry piers and steel and concrete superstructure. The

plans were completed on June 25, 1921, and bids received on June 30, 1921. The lowest bid was that of the Aberthaw Construction Company for $133,027. On June 30, 1921, at their request, a hearing was given by the Commission to representatives of Essex County and the city of Lynn, at which hearing the representatives of the city of Lynn and the General Electric Company offered to furnish funds and their services to rebuild the burned portion of the bridge immediately, with temporary wooden construction. Their offer was accepted by the Commission, and the work was begun on July 5, 1921, by W. S. Rendle, Contractor, and was prosecuted day and night until July 18, 1921, when it had reached a point where it was safe to open to public traffic. The whole work was completed on July 28, 1921. The cost of the work, as reported by the representatives of the General Electric Company, has been $37,853.15.

Middlesex Fells Parkway.

At the request of abutting owners, in the section of the westerly side of the parkway between Myrtle Street and Amaranth Street, granolithic walks have been laid. The work was done in August by Alexander Palladino, lowest bidder, at a total cost of $421.16. One-half the cost was paid by the abutting owners.

A section of the east roadway between Medford Street and Adams Street, a distance of 1,400 feet, has been resurfaced with bituminous macadam. The work has been done by the forces of the Middlesex Fells Division under Superintendent Habberley. About 5,600 square yards have been built at a total cost of $8,051.40.

Mystic Valley Parkway.

A section of Mystic Valley Parkway, from a point opposite the dam, between the lower and upper lakes, to the end of the work built last year, a distance of about 1,780 feet, has been resurfaced with bituminous macadam. The work has been done by the forces of the division at a total cost of $10,003.80.

Old Colony Parkway.

On January 19, 1921, bids were again received for the construction of a permanent Neponset bridge. As before, alternative bids were asked for two designs, one for the arch type and one for the rein-

forced concrete girder type. The lowest bid for the arch type was that of George M. Bryne, $795,779.50. The lowest bid for the girder type was that of the Bay State Dredging and Contracting Company, $662,136.50. Both bids were considerably in excess of the funds available for the construction of the bridge and all bids were rejected and the work indefinitely postponed.

Conditions and prices appearing to be more favorable, bids were again asked on October 27, 1921. At this time bids were asked for the same types of bridge as in January, with the addition of a steel plate girder type. The lowest bids were as follows: — arch type, Coleman Brothers, $653,133.50; concrete girder type, Bay State Dredging and Contracting Company, $463,645; steel girder type, Bay State Dredging and Contracting Company, $445,300. Although considerable reduction is shown between the bids of January and October, the funds available were not sufficient to proceed with the work; therefore all bids were again rejected.

Under contract with the Boston Development and Sanitary Company, 9,623 cubic yards of ashes have been deposited on the parkway for filling near the approach to Columbia Road north of Mount Vernon Street. The total cost has been $2,155.64.

Revere Beach Parkway.

A concrete retaining wall has been built on the northerly line of the parkway along Spalding Street to prevent the long slope of the approach to the railroad bridge from encroaching on Spalding Street. Work was done by Alexander Palladino, lowest bidder, at a total cost of $1,592.64. Work was begun on August 5, 1921, and was completed on October 31, 1921.

A section of Revere Beach Parkway, from Mill Street to Railroad Avenue, has been resurfaced with bituminous macadam by the forces of the Revere Beach Division. About 2,880 square yards have been laid at a total cost of $4,312.29.

West Roxbury Parkway.

On March 17, 1921, bids were received for the construction of the parkway from Belgrade Avenue to Centre Street, including the bridge over the New York, New Haven & Hartford Railroad. The contract was awarded to the lowest bidder, Coleman Brothers, Inc.

The work was begun on March 24, 1921, and was completed on August 13, 1921, at a total cost of $54,971.28. With the completion of this section, which was opened to public travel on August 22, 1921, an excellent route is now provided from Stony Brook Reservation and Washington Street via Centre Street, which has recently been reconstructed by the city of Boston, to Jamaicaway.

Land has been transferred by this Commission to the care and control of the Public Works Department of the Commonwealth for the widening of Washington Street, from LaGrange Street to the West Roxbury Parkway, and the work of widening is now in progress.

Granolithic walks have been constructed over the section from Anawam Avenue to Centre Street to conform to those constructed by the city of Boston in the improvement of intersecting streets. Work was done by Alexander Palladino. The work was begun on August 20, 1921, and completed on August 29, 1921, at a total cost of $914.72.

Winthrop Parkway.

Plans and specifications for construction of sea wall and section of the parkway, from Ocean Avenue, Revere, to Sewall Avenue, Winthrop, have been prepared. Bids were received on October 13, 1921, the lowest bid being that of A. G. Tomasello, $265,147.50. As the funds available were not sufficient to do the work called for in these proposals all bids were rejected and the work postponed.

Reservations.

Blue Hills Reservation.

Surveys, plans and estimates for roadway from Administration Road to the summit of Chickatawbut Hill have been completed.

Bunker Hill Reservation.

Plans and specifications have been prepared for building additional iron fences and repairing existing fences. Bids were received on April 28, 1921, and contract awarded to the lowest bidder, the W. A. Snow Iron Works. Work was begun on May 9, 1921, and completed on July 8, 1921. Total cost, $4,201.39.

Charles River Reservation, Upper Division.

Work of widening Nonantum Road at its junction with Maple Street, Newton, to conform to Maple Street as recently widened by the city of Newton, has been completed. Bids were received on April 21, 1921, and contract awarded to lowest bidder, Alexander Palladino. Work was begun on May 2, 1921, and completed on May 28, 1921, at a cost of $1,870.51.

Section of Charles River Road southerly from Arsenal Street, a distance of about 1,400 feet, has been graded and resurfaced with bituminous macadam by the forces of the division under Superintendent Gilman. About 6,223 square yards were laid at a total cost of $5,140.32.

Plans and specifications have been prepared by Desmond & Lord, architects, for combined sanitary and garage near Riverside headquarters station. Bids were received on October 31, 1921, and contract awarded to lowest bidder, Archdeacon & Sullivan. Work was begun on November 15, 1921, and is now in progress.

Charles River Reservation, Lower Basin.

The act authorizing the construction of Charles River Basin provides that the channels and canals shall be maintained at the specified depths. In some portions of Broad and Lechmere canals shoaling has occurred during the past five years, requiring dredging of about 13,572 cubic yards of material. Bids were received on May 12, 1921, and contract awarded to W. S. Rendle, lowest bidder. Work was begun on June 9, 1921, and was completed on July 25, 1921, at a total cost of $6,759.61.

Wooden pile dolphins at the approaches to Lechmere Canal and the ship lock have been rebuilt and repaired. Bids were received on June 2, 1921, and contract awarded to the lowest bidder, Rendle-Stoddard Company. Work was begun on July 11, 1921, and was completed on August 5, 1921, at a total cost of $2,885.11.

Preliminary surveys, studies and estimates have been in progress for rebuilding Cottage Farm bridge over the Charles River.

Cambridge Parkway.

The iron fences on the river walls have been repaired by replacing considerable of the top rail which had become dangerously weak on account of corrosion, and replacing several posts and other parts of the fences which were broken. This work was done by the Progressive Iron Works, lowest bidder. Work was begun on June 20, 1921, and was completed on August 11, 1921, at a total cost of $1,738.48.

All the iron fences along the river walls of the parkway have been painted with two coats of paint. The work was done by Maurice M. Devine, lowest bidder. Work was begun on July 20, 1921, and was completed on August 11, 1921, at a total cost of $1,892.13.

The work of repairing the roadways of the Cambridge Parkway, as far as the funds available would permit, has been done by the forces of the division under Superintendent West. The work has principally consisted of surfacing with bituminous macadam strips on each side of the travel way along the gutters, varying in width from 3 to 10 feet, the setting of edgestone, trimming and grading planting spaces and walks. The work necessary to put the roads in good condition is about one-half completed, and should be continued during the coming year.

Lynn Shore Reservation.

Extensive repairs have been made to the concrete sea wall in the vicinity of Red Rock section. The repairs generally were made by the use of the cement gun. The work has been done by the forces of the Division at a total cost of $7,197.85.

Middlesex Fells Reservation.

The section of Woodland Road from Pond Street to the southerly end of the New England Sanitarium, a distance of 2,800 feet, has been resurfaced with bituminous macadam by the forces of the division. About 6,800 square yards have been resurfaced at a cost of $8,529.41.

Plans and specifications have been prepared for construction of concrete garage and storage shed of five stalls at the Pond Street headquarters service yard. Bids were received on October 27, 1921,

and contract awarded to S. L. Milton, lowest bidder. Work was begun on November 2, 1921, and is now in progress.

Plans and specifications for a three-car garage at the police station, Forest Street, Medford, have been prepared by Desmond & Lord, architects. Bids were received on October 31, 1921, and contract awarded to Archdeacon & Sullivan, lowest bidder. Work was begun on November 9, 1921, and is now in progress.

Mystic River Reservation.

Plans and specifications have been prepared for the widening of Cradock bridge, Main Street, Medford, as provided for by chapter 398, Acts of 1921. Bids were received on September 1, 1921, and contract awarded to lowest bidder, Simpson Brothers Corporation. Work was begun on September 8, 1921, and completed on November 30, 1921.

Nantasket Beach Reservation.

Plans have been prepared for a four-car garage and storage sheds at the northerly end of the reservation. The foundations for the building have been constructed during November by the forces of the division. It is expected to complete the plans and build the superstructure next spring.

The parking space for automobiles south of the bath-house has been enlarged by covering the remaining area of sand with a layer of clay. A portion of this parking space was treated in this manner in the fall of 1920 and results were very satisfactory. Space is now provided for the parking of about 1,000 automobiles on this one area alone.

Quincy Shore Reservation.

Bids were received on November 10, 1921, for furnishing filling material for repairs to the shore slopes and to provide for future possible widening of the roadway. Contract was awarded to Gerrish Dredging Company, lowest bidder, and the work will probably begin about December 1, 1921. It is proposed to obtain the material from Quincy Bay and place it in the slopes with hydraulic dredge.

Winthrop Shore Reservation.

Repairs have been made to a section of the sea wall near Sturgis Street. At this point a bastion projected over the general line of the wall and was particularly subject to damage by severe storms.

It was considerably wrecked during the storm of last November, and in the repairs the bastion was removed and the wall built back on the line of the main wall. Bids were received on April 7, 1921, and contract awarded to lowest bidder, Harvey L. Maney. Work was begun on April 14, 1921, and was completed on June 24, 1921, at a total cost of $9,705.26.

Drawbridges and Locks.

All work of maintenance and operation of drawbridges, locks, sluices and tide gates has been under the direction and supervision of this department. General repairs have been made to all bridges under the care and control of the Commission, the work being supervised by this department. The work of breaking ice in the channels and canals in the Charles River Basin, which was done by the boat owned by the Commission, was not as difficult as in the winter of 1919–20, but the services of the boat were required continually from about December 15, 1920, to March 15, 1921. The cost of this work, including the operation, maintenance and repairs of the boat, was $6,149.23.

The large gates in the ship lock were painted in April of this year. The work of cleaning and painting was done by the forces employed at the dam, with the assistance of painters furnished under contract with Maurice M. Devine. During the progress of the work it was necessary to close the lock from the passage of vessels for two periods, from April 4, 1921, to April 14, 1921, and from April 20, 1921, to April 30, 1921.

The floor system of the drawbridge at Charles River Dam was entirely renewed. Work was done by the forces employed at the dam, with the assistance of bridge carpenters furnished by Rendle-Stoddard Company. Work was begun on June 27, 1921, and was completed on August 18, 1921.

The floor system of the drawbridge of Wellington bridge has been rebuilt during the month of November. The work has been done by the forces employed on the bridges, with the assistance of bridge carpenters furnished by Rendle-Stoddard Company.

The following is a record of the traffic through locks and drawbridges during the year: —

Charles River Dam and Locks.

Main Lock.

Number of openings	3,531
Number of vessels	2,912
Number of boats	3,257
Lumber (feet B. M.)	2,361,265
Coal (tons)	260,475
Oil (barrels)	299,000
Sand (tons)	102,453
Gravel (tons)	42,605
Empty barrels	4,437
Rubble stone (tons)	5,700
Granite (tons)	2,577
Piling (pieces)	522
Water (gallons)	3,000
Tallow (drums)	2,200
Miscellaneous (tons)	1,250

There were 1,841 drawbridge openings.

The small boat lock was not operated this year.

Wellington Bridge.

Number of openings	144
Number of vessels	186

Malden River Bridge.

Number of openings	712
Number of vessels	1,298

Saugus River Bridge.

Number of openings	137
Number of vessels	221

Cradock Bridge Lock.

Number of openings	833
Number of boats	1,160
Number of boats over rollway	182

Temporary Neponset Bridge.

Number of openings	409
Number of vessels	616
Coal (tons)	57,219

General.

The work of road repairs and maintenance, which has consisted generally of surface treatments and patching with bituminous materials, has been done by the forces of the various divisions under the supervision and direction of the engineering department. Work of resurfacing portions of the parkway and reservation roads, where most necessary, has been carried on by the forces of each division to such extent as the funds available would permit. In the last ten years considerable progress has been made in this work of reconstruction and resurfacing of the park roads, to meet the requirements of motor car traffic, at an expenditure of from $30,000 to $40,000 each year. To complete the necessary work of reconstructing, widening and resurfacing the estimated cost is about $600,000. It is desirable that this work be done as soon as possible, but, if it seems inexpedient to expend this amount at once, it may be spread over a period of years, as in the past. If the latter course is adopted, sufficient sums for the maintenance of the existing surfaces should be provided.

All bridges under the care and control of the Commission have been inspected twice during the year and reports made with recommendations and estimates of cost for repairs.

The following tables are appended to this report: Table 1, data relating to Metropolitan Park System, and Table 2, summary of cost of road repairs and maintenance.

Respectfully submitted,

JOHN R. RABLIN,
Director of Park Engineering.

December 1, 1921.

TABLE 1. — DATA RELATING TO METROPOLITAN PARK SYSTEM.

Areas of Reservations and Parkways.

	Acres.	
Reservations:		
Blue Hills	4,906.43	
Bunker Hill	6.05	
Middlesex Fells	1,845.77	
Stony Brook	463.72	
Beaver Brook	58.33	
Hart's Hill	22.97	
Hemlock Gorge	23.06	
Charles River	800.33	
Mystic River	54.23	
Neponset River	922.59	
King's Beach and Lynn Shore	22.69	
Revere Beach	64.99	
Winthrop Shore	16.83	
Quincy Shore	32.91	
Nantasket Beach	25.59	
Total		9,266.49
Parkways:		
Hammond Pond	183.69	
Blue Hills	83.58	
Old Colony	53.18	
Woburn	23.24	
Middlesex Fells	82.12	
Revere Beach	126.88	
Mystic Valley	337.89	
Neponset River	74.11	
Fresh Pond	12.40	
Lynn Fells	7.72	
Furnace Brook	101.25	
Nahant Beach	81.98	
Lynnway	5.15	
Winthrop	8.04	
Dedham	37.14	
Alewife Brook	144.88	
West Roxbury	72.37	
Quannapowitt	13.47	
Total		1,451.11
Grand total, reservations and parkways		10,715.58

Lengths of Formal Roads constructed.

Reservations:	Double Roadways (Miles).	Single Roadways (Miles).	Total Miles.
Charles River	–	5.28	
Lynn Shore	–	1.12	
Quincy Shore	–	2.24	
Revere Beach	–	2.70	
Winthrop Shore	–	1.07	
			12.41
Parkways:			
Alewife Brook	–	.70	
Blue Hills	1.46	1.61	
Cambridge	.37	3.19	
Dedham	–	.89	
Fresh Pond	–	.50	
Furnace Brook	–	4.06	
Lynn Fells	–	1.05	
Lynnway	–	.68	
Middlesex Fells	4.10	1.77	
Mystic Valley	–	6.17	
Nahant Beach	–	.50	
Neponset River	–	.53	
Revere Beach	1.45	3.73	
West Roxbury	–	.93	
Winthrop	–	.49	
Woburn	–	1.38	
			28.18
	7.38*		
*Equivalent in miles of single roadway			14.76

Highways transferred by or taken from cities and towns:	Miles.	
Alewife Brook Parkway	.44	
Blue Hills Reservation	1.23	
Charles River Reservation	.39	
Middlesex Fells Reservation	6.63	
Nantasket Beach Reservation	.71	
		9.40
Length of automobile roads in reservations:		
Blue Hills	5.35	
Charles River	2.80	
Middlesex Fells	4.06	
Stony Brook	3.25	
		15.46
Grand total		80.21

All above roads open to automobile traffic.

Lengths of Carriage Roads in Reservations.

	Miles.
Blue Hills Reservation	25.58
Middlesex Fells Reservation	13.79
Stony Brook Reservation	1.60
Beaver Brook Reservation	.22
Charles River Reservation	.89
Total	42.08

Lights in Parkways and Reservations.

	Lights.
Alewife Brook Parkway (arc lights)	9
Blue Hills Parkway (Welsbach gas)	80
Charles River Reservation, Upper Division, Soldiers' Field Road, Arsenal Road and North Beacon Street (electric)	16
Charles River Reservation, Boston Embankment (electric)	106
Cambridge Parkway (electric)	200
Charles River Reservation, Lower Basin, Dam and Lock (electric)	16
Fresh Pond Parkway (electric)	15
Furnace Brook Parkway (Welsbach gas)	[1] 45
Lynn Fells Parkway (Welsbach naphtha)	17
Lynn Shore Reservation (electric)	28
Lynnway (electric)	10
Middlesex Fells Parkway (Welsbach naphtha)	259
Middlesex Fells Reservation (Welsbach naphtha)	29
Middlesex Fells Reservation (electric)	48
Mystic Valley Parkway (Welsbach naphtha)	60
Nahant Beach Parkway (electric)	[2] 7
Nantasket Beach Reservation (electric)	[3], [4] 29
Old Colony Parkway (arc)	3
Quincy Shore Reservation (Welsbach gas)	[5] 56
Quincy Shore Reservation (electric)	[6] 3
Revere Beach Parkway (Welsbach naphtha)	165
Revere Beach Parkway (arc)	6
Revere Beach Reservation (Welsbach gas)	53
Revere Beach Reservation (electric)	[7] 34
Winthrop Parkway (Welsbach naphtha)	6
Winthrop Shore Reservation (electric)	7
Total	1,311

[1] Seventy-eight lights to October 1.
[2] Five additional lights in summer.
[3] Fourteen additional lights in summer.
[4] Three additional lights in summer south of bath-house, near wall.
[5] Seventy-eight lights to October 1.
[6] Discontinued April 9, 1921.
[7] Three hundred and forty-eight additional lights in summer.

Miles of Seashore.

	Miles.
Lynn Shore	1.50
Nahant Beach	3.92
Revere Beach	2.74
Winthrop Shore	1.71
Nantasket Beach	1.02
Quincy Shore	2.19
Total	13.08

Lengths of Sea Walls.

	Miles.
Lynn Shore	1.30
Revere Beach at Northern Circle	.08
Revere Beach at Eliot Circle	.15
Revere Beach, shore protection, bath-house shelter to Revere Street shelter	.29
Revere Beach, shore protection, south of Northern Circle	.28
Winthrop Shore, bridge to Great Head	1.04
Winthrop Shore, bridge to Grover's Cliff	.23
Quincy Shore Reservation, southerly end	.15
Nantasket Beach Reservation	.43
Winthrop Parkway, near Leverett Avenue, Revere	.12
Total	4.07

Miles of River Bank.

	Miles.
Charles River	32.61
Mystic River	8.16
Neponset River	15.86
Alewife Brook	4.50
Total	61.13

Bridges.

Reinforced concrete bridges	13
Steel bridges	8
Wooden bridges	[1] 5
Drawbridges	5
Footbridges	12
Total	43

[1] One-half of Wellington bridge rebuilt with concrete girders.

Culverts.

Reinforced concrete and other masonry culverts	37

Dams.

Beaver Brook Reservation, small wooden dams	2
Charles River Reservation, Charles River Basin tidal dam, 1,200 feet in length	1
Charles River Reservation, small stone dam in branch below Washington Street, Newton Lower Falls	1
Charles River Reservation, reinforced concrete dam at Washington Street, Newton Lower Falls, 200 feet in length	1
Hemlock Gorge Reservation, small stone masonry dam with stop planks, in gorge	1
Hemlock Gorge Reservation, small reinforced concrete dam on East Branch of river, Newton Upper Falls	1
Hemlock Gorge Reservation, reinforced concrete dam in Charles River at Boylston Street, Newton Upper Falls, 90 feet in length	1
Mystic River Reservation, reinforced concrete tidal dam at Cradock bridge, 100 feet in length; weirs, 400 feet in length	1
Total	9

Lock Gates, Sluice Gates and Tide Gates.

Charles River Reservation, Charles River Basin tidal dam, 6 lock gates, 13 sluice gates, 43 tide gates.
Mystic River Reservation, Cradock bridge tidal dam, 2 lock gates, 4 sluice gates, 8 tide gates.
Quincy Shore Reservation, 8 tide gates.
Revere Beach Parkway, 1 tide gate.

Police Signal System.

	Miles.
Blue Hills Division	$30\frac{1}{2}$
Middlesex Fells Division	$18\frac{1}{4}$
Nantasket Beach Division	$2\frac{1}{2}$
Charles River Reservation	10
Fresh Pond Parkway	$\frac{1}{2}$
Total	$61\frac{3}{4}$

Revere Beach Division police signal system, serving 11 miles of parkways and reservations, and Middlesex Fells Division, serving $1\frac{1}{2}$ miles of parkway, on wires leased from the New England Telephone and Telegraph Company. Two miles of wire in Blue Hills Reservation leased from the New England Telephone and Telegraph Company.

Buildings.

	Hammond Pond Parkway.	Blue Hills.	Middlesex Fells.	Revere Beach.	Charles River Reservation.		Nantasket Beach.	Beaver Brook.	Totals.
					Lower Basin.	Upper Division.			
Police stations	–	1	1	2	–	2	1	–	7
Substations	1	5	2	3	2	1	–	–	14
Separate work, headquarters	–	–	1	1	–	–	–	–	2
Stables	–	5	3	2	1	3	1	1	16
Superintendents' houses	–	1	–	1	–	1	–	1	4
Dwellings	–	8	3	–	–	2	2	–	15
Garages	–	4	4	2	1	2	1	–	13
Carpenter shops	–	1	1	1	–	1	–	–	4
Paint shops	–	–	1	1	1	–	1	–	4
Other shops	–	–	3	2	–	4	1	–	10
Sheds	–	2	6	3	1	–	–	–	12
Miscellaneous	–	3	12	4	5	4	4	2	34
Band stands	–	2	3	3	1	6	1	1	17
Shelters	–	8	1	4	1	1	1	1	17
Refectories	–	2	–	–	1	–	–	–	3
Hotel	–	–	–	–	–	–	1	–	1
Sanitaries	–	3	6	2	1	4	7	1	24
Boathouses	–	–	–	1	3	6	–	–	10
Bath-houses	–	3	2	2	2	3	1	–	13
Laundries	–	–	–	1	–	–	1	–	2
Coal bin	–	–	–	–	–	–	1	–	1
									223

TABLE 2. — SUMMARY OF COST OF ROAD REPAIRS AND MAINTENANCE, 1921.

PARKWAY OR RESERVATION.	Length (Feet).	Width of Roadway (Feet).	Square Yards.	Cost per Square Yard in Detail.							Total Amount.	Remarks.	Location.
				Labor (Cents).	Broken Stone (Cents).	Sand (Cents).	Bituminous Binder or Dust Layer.			Total Cost (Cents).			
							Kind of Material.	Gallons per Square Yard.	Cost (Cents).				
Blue Hills Parkway	800	30–36	3,274	–	28.37	–	Topeka	–	185.00	213.37	$6,985.89	Resurfacing	Mattapan bridge to Elliot Street, Traffic Road, Milton.
Blue Hills Parkway	1,117	26	3,228	–	–	–	Bitoslag	–	178.00	178.00	5,745.84	Resurfacing	Station No. 58+64 to Station No. 69+81, Milton.
Blue Hills Parkway	4,000	26	11,555	.92	–	–	Tarine No. 1 (American Tar Company).	.34	5.01	5.95	686.75	Surface treatment.	Brook Road to Station No. 58, Traffic Road, Milton.
Blue Hills Parkway	2,000	36	8,000	3.50	–	–	Asphaltic Oil No. 6 (Standard Oil Company).	.25	2.25	5.75	459 85	Surface treatment.	Canton Avenue, northerly, Milton.
Blue Hills Reservation	6,800	8	6,044	5.94	–	–	Asphaltic Oil No. 6	.29	2.98	8.92	538.97	Surface treatment.	Wampatuck Road, Quincy.
Blue Hills Reservation	9,900	8	8,800	5.64	–	–	Asphaltic Oil No. 6	.34	3.06	8.70	765.95	Surface treatment.	Administration Road, Milton and Quincy.
Blue Hills Reservation	6,500	8	5,777	4.11	–	–	Asphaltic Oil No. 6	.40	3.11	7.22	417.35	Surface treatment.	Border Road, Randolph Avenue to Hillside Street, Milton.
Blue Hills Reservation	6,030	16	10,720	3.14	–	–	Asphaltic Oil No. 6	.48	4.51	7.65	819.75	Surface treatment.	Unquity Road, Milton.
Blue Hills Reservation	1,600	8	1,422	4.43	–	–	Tarine No. 1	.34	5.09	9.52	135.35	Surface treatment.	Unquity Road, Milton.
Blue Hills Reservation	800	16	1,422	4.37	–	–	Tarine No. 1	.34	5.09	9.46	134.50	Surface treatment.	Harland Street, Milton.
Charles River Reservation.	1,400	40	6,223	27.63	36.25	.64	Standard Binder A (Standard Oil Company).	1.45	18.08	82.60	5,140.32	Resurfacing	Arsenal Street, westerly, Watertown.
Charles River Reservation.	525	26	1,517	20.56	13.18	–	Standard Binder A	1.12	14.01	47.75	724.40	Resurfacing	Everett Street, Boston.
Charles River Reservation.	9,300	13	13,433	.49	–	–	Asphaltic Oil No. 6	.15	1.37	1.86	250.10	Surface treatment.	Quinobequin Road, Newton.
Charles River Reservation.	4,700	12	6,267	.98	–	–	Asphaltic Oil No. 6	.20	1.79	2.77	173.85	Surface treatment.	Forest Grove Road, Newton and Waltham.
Dedham Parkway	5,174	32	18,396	2.13	–	–	Standard Binder A	.51	6.48	8.61	1,584.75	Surface treatment.	Turtle Pond Road to Emmett Avenue, Dedham and Boston.
Furnace Brook Parkway.	2,300	24	6,133	3.29	–	–	Tarine No. 1	.32	4.60	7.89	434.00	Surface treatment.	Blacks Creek bridge to Park Lane, Quincy.

Lynn Shore Reservation.	2,041	40	9,071	2.00	3.24	–	Tar Binder No. 2 (Independent Coal Tar Company).	.44	6.17	11.41	1,035.17	Surface treatment.	Nahant Street to Prescott Place, Lynn.
Middlesex Fells Parkway.	1,400	36	5,600	73.25	42.41	–	Standard Binder A .	2.00	25.20	140.86	7,878.05	Resurfacing .	Medford Street to Adams Street, easterly roadway, Malden.
Middlesex Fells Reservation.	2,800	20–24	6,800	67.93	37.11	–	Standard Binder A .	1.55	19.30	124.34	8,455.20	Resurfacing .	Woodland Road, Pond Street to sanitarium, south entrance, Stoneham.
Middlesex Fells Reservation.	11,650	20	25,889	4.90	–	–	Asphaltic Oil No. 6 .	.35	3.10	8.00	2,071.91	Surface treatment.	South Border Road, Winchester and Medford.
Mystic Valley Parkway.	3,485	30	11,617	5.00	–	–	Asphaltic Oil No. 6 .	.47	4.20	9.20	1,068.38	Surface treatment.	Medford Street to Mystic Street, Arlington.
Mystic Valley Parkway.	1,780	36	7,120	76.46	37.04	–	Standard Binder A .	1.82	23.00	136.50	9,719.10	Resurfacing .	From Station No. 62 to Station No. 56, and Station No. 50+15 to dam, Winchester and Medford.
Mystic Valley Parkway.	585	36	2,340	3.00	3.00	–	Standard Binder A .	.50	6.17	12.17	284.70	Surface treatment.	From Station No. 56 to Station No. 50+15, Winchester and Medford.
Nantasket Beach Reservation.	3,760	40	16,711	.55	1.97	–	Tarvia B (Barrett Manufacturing Company).	.23	3.68	6.20	1,036.60	Surface treatment.	Nantasket Avenue, Hull.
Nantasket Beach Reservation.	3,760	8	3,380	37.82	13.28	–	Tarvia B . . .	.30	4.76	55.86	1,887.98	Resurfacing .	Nantasket Avenue, along track location, Hull.
Revere Beach Parkway	2,345	28	7,296	2.27	3.18	–	Tarine No. 1 . .	.51	7.35	12.80	933.97	Surface treatment.	Fellsway to Malden River bridge, Medford.
Revere Beach Parkway	1,740	36	6,960	3.73	3.30	–	Tarine No. 1 . .	.29	4.17	11.20	779.27	Surface treatment.	Everett Avenue to Washington Avenue, Chelsea.
Revere Beach Parkway	3,320	26	9,591	1.91	3.19	–	Tarine No. 1 . .	.47	6.81	11.91	1,141.93	Surface treatment.	Second Street to Everett Avenue, Everett.
Revere Beach Parkway	720	36	2,880	58.36	46.75	–	Tarvia X . . .	2.84	41.18	146.29	4,213.29	Resurfacing .	Railroad Avenue to Station No. 72+70, Revere.
Revere Beach Parkway	330	36	1,320	2.05	3.18	–	Tarvia X . . .	.39	5.71	10.94	144.40	Surface treatment.	Station No. 72+70 to Mill Street, Revere.
Revere Beach Parkway	300	36	1,200	3.54	3.17	–	Tarine No. 1 . .	.40	5.80	12.51	150.10	Surface treatment.	Washington Avenue to Winthrop Street, Chelsea.
Winthrop Shore Reservation.	4,710	36	18,840	4.10	–	–	Tarvia A . . .	.27	4.06	8.16	1,536.43	Surface treatment.	Grovers Avenue to Station No. 42, Winthrop.

REPORT OF THE DIRECTOR AND CHIEF ENGINEER OF WATER DIVISION.

JAMES A. BAILEY, *Commissioner, Metropolitan District Commission.*

SIR: — I have the honor to submit the following report of the construction and maintenance operations of the Water Division for the calendar year 1921.

ORGANIZATION.

The principal assistants employed in directing and supervising the work of the Division at the close of last year have continued in service for another year, and are as follows: —

John L. Howard	Deputy Chief Engineer.
Elliot R. B. Allardice	Superintendent of Wachusett Section.
Frank S. Hart	Superintendent of Sudbury Section.
Samuel E. Killam	Superintendent of Distribution Section.
Arthur E. O'Neil	Superintendent of Pumping Stations.
Alfred O. Doane	Engineer in charge of Mechanical Engineering and Inspection.
William W. Locke	Sanitary Inspector of Watersheds.
Clifford Foss	Engineer in charge of Distribution Civil Engineering.
Benjamin F. Hancox	Head Draftsman.
James W. Killam	Assistant Engineer in charge of Coal and Oil Laboratory.
William E. Whittaker	Chief Clerk in charge of General Office.
Charles E. Livermore	Biologist in charge of Biological Laboratory.

Including these principal assistants the number of supervising, engineering and clerical employees was 45 at the beginning of the year and 43 at the end of the year.

In addition to these forces the labor forces engaged in maintaining and operating the reservoirs, aqueducts, pipe lines, hydro-electric stations and pumping stations, and doing miscellaneous construction work, have been as follows: —

Section.	Number of Employees.			
	Beginning of Year.	End of Year.	Maximum.	Average.
Wachusett section	48	48	83	65
Sudbury section	74	72	74	72
Distribution section	102	106	109	100
Pumping stations	74	73	76	74
Total labor forces	298	299	342	311

CONSTRUCTION.

Meters and Connections.

In connection with the work of relocating the meters and connections on the pipe lines acquired from the city of Boston in 1913, the pavement in Washington Street, Brookline, was permanently repaired where disturbed by installing Venturi meters and valves near Brookline Avenue in 1919. The work was done by James Driscoll & Son, under contract No. 8, in May and June, and included 539 square yards of brick pavement on a concrete base. The total expenditures in connection with the work amount to $3,589.35.

All of the work contemplated on meters and connections under the provisions of chapter 172 of the General Acts of 1916 is now completed, with the exception of moving the Venturi meter in the 48-inch southern high-service main from Boylston Street, at Fisher Avenue, in Brookline, to the Boston–Brookline boundary line at Washington Street.

Southern Extra High-service Pipe Line for Hyde Park and Milton.

The additional southern extra high-service pipe line for Hyde Park and Milton, authorized by chapter 172 of the General Acts of 1916, was completed with the laying of the 12-inch pipe line under the Neponset River and the New York, New Haven & Hartford Railroad, between West Street and Vose Avenue, Hyde Park.

The pipes and special castings for the work were furnished by the Division and were laid by the George T. Rendle Company, under contract No. 11. The work was begun September 19 and was completed December 1 and the line was put into regular service December 31. This section of pipe line includes 217 feet of 12-inch

pipes with flexible joints and 143 feet of 12-inch pipes with ordinary joints. The cost of the pipes and special castings is $2,753.24; of laying the pipes, $5,752.81; of engineering and additional work, $869.44; making the total cost $9,375.49.

Pumping Equipment, Southern High Service.

The work of installing additional equipment at the Chestnut Hill pumping stations, under the provisions of chapter 530 of the Acts of 1920, is well advanced.

The Snow cross-compound pumping engine, No. 16, built by the Worthington Pump and Machinery Corporation, has a rated pumping capacity of 15,000,000 gallons a day against a head of 190 feet. The steam cylinders are 23 inches and 54 inches in diameter; the double-acting pump plungers are $23\frac{3}{4}$ inches in diameter; the stroke is 36 inches, and when pumping at full capacity the engine operates at a speed of 38.4 revolutions a minute.

The two new vertical fire-tube boilers, Nos. 20 and 21, built by the D. M. Dillon Steam Boiler Works, are each 98 inches in diameter, 24 feet in height and contain 400 tubes 2 inches in diameter, and are fitted with Perfection shaking grates.

In connection with this installation a 35-kilowatt electric lighting unit, purchased in 1920 from the Ames Iron Works, was set up in station No. 2 by the regular pumping service force; the three old horizontal boilers, Nos. 1, 2 and 3 at station No. 1 were sold with settings to Thomas Rush, and removed to provide space for the new boilers which were delivered at the station on cars about the first of June, and were unloaded and set on foundations by Frazer Pritchard, who also removed the old engine, No. 2, to provide space for the new engine.

The old foundations were rebuilt for the new boilers and engine by the regular distribution section force, which also laid the new 36-inch suction and 30-inch discharge pipe and installed the track hopper for the new coal conveyor.

The galleries for the boilers were made and erected by the Norfolk Iron Company, and the regular pumping service force erected the flue, connected up the feed water and steam piping, and equipped the boilers with gages, water columns and other accessories.

To provide space for the new engine foundation the machine shop in the basement of station No. 1, back of engine No. 2 founda-

tion, was relocated in the southerly portion of the stable which, on account of changes during recent years, is no longer required for horses, and the new location of the shop midway between the pumping stations is more convenient than the old location.

An Underwood coal conveyor has been purchased for station No. 1 to replace the existing obsolete hoist which is in poor condition. The new concrete track hopper and elevator pit have been installed and the erection of the conveyor is in progress.

Of the $200,000 appropriated for the additional machinery and appurtenances $101,675.90 has been expended, obligations under existing contracts amount to $40,201.59 and some minor expenditures will be necessary to complete all of the work contemplated.

Arlington Reservoir.

Replacement of the existing standpipe on Arlington Heights with a large steel tank enclosed in a masonry tower was authorized by chapter 530 of the Acts of 1920 and the sum of $175,000 was appropriated for the purpose.

Studies and plans for this work having been prepared, the additional land needed for the reservoir was acquired from the town of Arlington by taking dated October 13, 1920, and on October 10, 1921, a contract was made with Harvey L. Maney for constructing the concrete foundation. The contract included the excavation of about 1,400 cubic yards of earth, 100 cubic yards of rock and the placing of about 1,000 cubic yards of concrete, and the work was completed December 24. The total value of the work done under the contract is $10,557.

On December 29 a contract was awarded to Walsh's Holyoke Steam Boiler Works for removing the existing tank and erecting a new steel tank 75 feet in diameter and 61.25 feet in height, on the same site, for the sum of $29,737.

Northern High-service Pipe Lines.

Plans have been completed for the additional pipe lines authorized for reinforcing the existing northern high-service mains in Everett, Malden, Medford and Somerville. In connection with this work a permit, dated December 28, 1921, has been obtained from the War Department authorizing the laying of a 20-inch water pipe across the Mystic River in Medford, about 1 mile upstream from Well-

ington bridge, at a depth of not less than 10 feet below mean low water, in accordance with our plan.

The purchase of the necessary pipes and special castings for these pipe lines within a few weeks is contemplated so that pipe laying can be begun early in the spring.

Pumping Equipment, Northern High Service.

On account of continued high prices, the work of installing additional equipment at the Spot Pond pumping station has been deferred but further studies have been made of the special requirements at this station to determine the best equipment for the service.

Weston Aqueduct Supply Main.

Surveys have been made of the southern portion of the proposed supply main from the Weston Aqueduct to the northern low-service district, at times when the engineers were available for this work.

MAINTENANCE.

Precipitation and Yield of Watersheds.

The annual precipitation and yield from the watersheds was about normal, considerable excess precipitation in April, July and November making up the deficiency in several other months.

Between June 15 and December 15 the city of Worcester discharged 224,800,000 gallons of water into the Wachusett Reservoir watershed from the area formerly tributary to the reservoir which was diverted in 1911. By agreement with the city a payment of $2 a million gallons is made for the water, but no payment is made for 1,818,200,000 gallons of water which was received at other times during the year, as the Wachusett Reservoir filled before June 15.

Storage Reservoirs.

The capacities of the storage reservoirs of the Metropolitan Water Works, the elevation of the water surfaces, and the quantity of water stored in each reservoir at the beginning and at the end of the year are shown by the following table: —

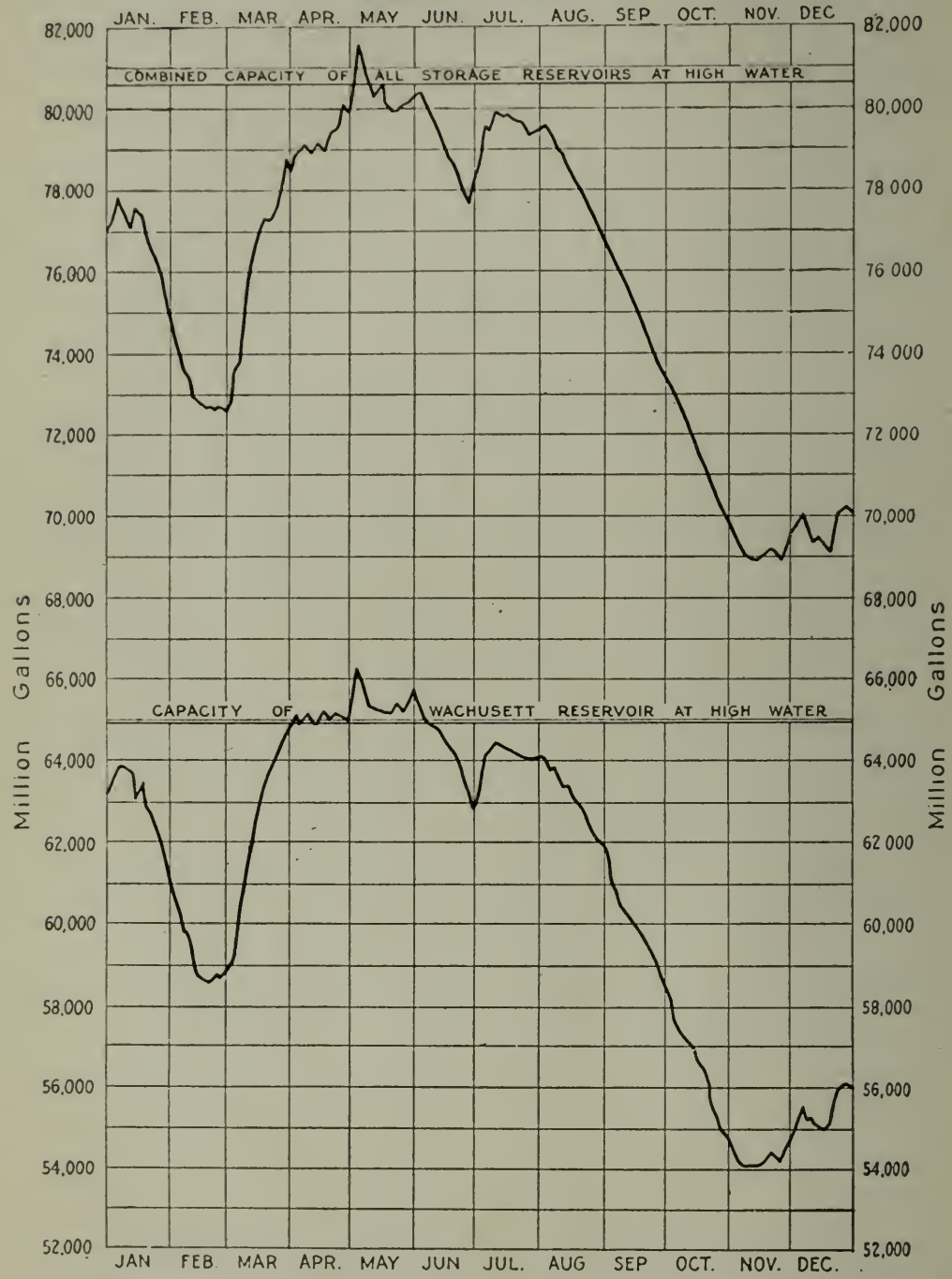
Storage Reservoirs.	Elevation[1] of High Water.	Capacity (Gallons).	Jan. 1, 1921.		Jan. 1, 1922.	
			Elevation[1] of Water Surface.	Amount stored (Gallons).	Elevation[1] of Water Surface.	Amount stored (Gallons).
Cochituate watershed: —						
Lake Cochituate[2] . .	144.36	2,097,100,000	142.48	1,655,600,000	143.04	1,785,700,000
Sudbury watershed: —						
Sudbury Reservoir .	260.00	7,253,500,000	257.73[3]	6,317,000,000	257.84[3]	6,360,000,000
Framingham Reservoir No. 1.	169.32	289,900,000[4]	167.83	221,700,000	167.79	220,000,000
Framingham Reservoir No. 2.	177.87	529,900,000[4]	176.09	485,600,000	176.08	485,200,000
Framingham Reservoir No. 3.	186.74	1,180,000,000[4]	186.04	1,142,700,000	184.67	1,032,700,000
Ashland Reservoir . .	225.21	1,416,400,000	224.44	1,374,000,000	224.43	1,373,500,000
Hopkinton Reservoir .	305.00	1,520,900,000	304.13	1,466,500,000	304.10	1,464,600,000
Whitehall Reservoir .	337.91	1,256,900,000	336.43	971,400,000	336.94	1,068,800,000
Farm Pond . . .	159.25	167,500,000	159.03	155,700,000	159.03	155,700,000
Wachusett watershed: —						
Wachusett Reservoir .	395.00	64,968,000,000	393.75	63,292,000,000	388.21	56,072,600,000
Totals	–	80,680,100,000	–	77,082,200,000	–	70,018,800,000

[1] Elevation in feet above Boston City Base.
[2] Excluding Dudley Pond which was abandoned April 3, 1916.
[3] Below Circular Dam.
[4] To top of flashboards.

The diagram on page 44 shows the quantity of water stored in the Wachusett Reservoir, and the quantity stored in all the storage reservoirs combined during the year.

The table and diagram show the total storage which could be drained from the reservoirs. Special provisions would be necessary, however, to draw about 10,000,000,000 gallons of this storage for consumption, as it is below the outlet channels which can be conveniently used for regular service.

QUANTITY OF WATER STORED IN THE WACHUSETT RESERVOIR AND IN ALL THE STORAGE RESERVOIRS COMBINED DURING 1921



Wachusett Reservoir.

At the beginning of the year the water in Wachusett Reservoir was at elevation 393.75, and the quantity of water stored in the reservoir was 63,292,000,000 gallons. Beginning January 8 and continuing through February 12 water was wasted from the reservoir to provide storage capacity for the spring freshet flows, so as to utilize as much waste water as possible for generating electric energy. The reservoir filled to the designed high-water line, elevation 395, on April 2 and remained at about that elevation until June 10. The highest stage reached was elevation 396.06 on May 2 and the quantity of water stored in the reservoir was then 66,402,700,000 gallons.

The maximum rate at which water was wasted from the reservoir was 1,055,000,000 gallons per day on May 2, the flow being at the rate of 763,000,000 gallons per day at the wasteway and at the rate of 292,000,000 gallons per day through the waste pipes.

After August 1 the water in the reservoir dropped about 2.4 feet per month to elevation 386.62 on November 10, which was the lowest stage reached. At that time the quantity of water stored in the reservoir was 54,065,900,000 gallons.

During the year 9,693,200,000 gallons of water, or about 15 per cent of the capacity of the reservoir, was wasted into the Nashua River in addition to 558,600,000 gallons discharged into the river in accordance with the provisions of chapter 488 of the Acts of 1895. Of the waste water, 4,575,200,000 gallons were utilized for generating electric energy.

On September 7 a contract was made with the Central Building Company of Worcester for facing with granite the crest of the circular dam over which the Quinapoxet River flows as it enters the reservoir at Oakdale. The work includes the excavation of about 75 cubic yards of concrete masonry, the placing of about 70 cubic yards of granite masonry and the necessary incidental work. The granite facing is about 170 feet in length, 1 foot 8 inches in thickness and 7 feet 10 inches in width measured around the curved surface, which is rough pointed. The contract price for this work is $11,450 and at the close of the year about 90 per cent of the work is completed.

The tile and copper roof of the masonry building below the dam, used for offices and power station, temporarily repaired last year, has been permanently repaired this year at a cost of $1,800 by the W. P. Leavitt Sons Company and is now water tight.

Wire fences were erected for a distance of 9,112 feet, stone walls were repaired or topped with wire fencing for a distance of 3,120 feet and stone walls were rebuilt for a distance of 314 feet along property lines and highways. The posts for this work were obtained from the water works lands.

The usual miscellaneous work has been done in connection with the care of the reservoir, water works lands and buildings; the brush and weeds were cut and burned for a distance of 32 miles along the margin of the reservoir, adjacent highways and brooks and rivers which flow directly into the reservoir; a short stretch of shore line at South Bay was paved to protect the adjacent highway from erosion; extensive repairs were made on granolithic walks at the dam and alterations and repairs were made at all of the water works buildings.

Standing grass on 324 acres of water works land was sold for the sum of $1,856.95.

Many trees on water works lands and the shrubbery on the grounds about the dam were seriously damaged by the ice which formed on them during the sleet storm of November 26 to 29, and the scars will disfigure the landscape for many years.

Sudbury Reservoir.

From the first of the year until April 18, when the flashboards were placed on the overflow at the dam, the water in the Sudbury Reservoir was held about a foot below the crest of the overflow, but following the heavy rainfall the last of April about 57,000,000 gallons overflowed from the reservoir. During the summer and until the flashboards were removed on November 21, the water in the reservoir was held a few inches below the top of the flashboards.

From November 28 to December 1 the Electric Company was unable to take energy from the Sudbury power station because of damage to its transmission line from the ice which formed during the sleet storm, and it was necessary to draw 189,000,000 gallons of water through the lower gates under turbine No. 1 to maintain the water supply.

A sheet-iron building 18 feet in width and 19 feet in length was erected at the southerly end of the dam for storage of boat and flashboards during the winter.

The usual care has been taken of the reservoir lands and the grounds and structures at the dam. In connection with this work brush and weeds were mowed on the shore of the reservoir, structures were repaired, some painting was done, 8 tons of hay were cut, and the walks and drives were kept in order.

Framingham Reservoir No. 3.

As in former years the elevation of the water in Framingham Reservoir No. 3 has been regulated so as to secure efficient operation of the Sudbury power station and to maintain the supply in the Sudbury Aqueduct. The flashboards were not removed from the overflow at the dam during the year, but the elevation of the water varied through a range of 5 feet, and more than 7,500,000,000 gallons were wasted from the reservoir into Framingham Reservoir No. 1.

The gatehouse embankments and grounds at the dam were given the usual attention and sprouts and brush were cut in the lanes along the property lines.

Framingham Reservoirs Nos. 1 and 2, Ashland, Hopkinton and Whitehall Reservoirs.

No water has been drawn for water supply in recent years from the southerly portion of the Sudbury watershed, including the area of 46.98 square miles tributary to five of the storage reservoirs. The last draft for supply from Framingham Reservoir No. 1 was in 1903, from Framingham Reservoir No. 2 in 1912, and from Ashland, Hopkinton and Whitehall reservoirs in 1911. Water from these reservoirs is inferior in quality to the water from Wachusett, Sudbury and Framingham No. 3 reservoirs and is not now acceptable for use in its natural state. The reservoirs are therefore kept substantially full during the year and the entire yield tributary thereto is wasted into the Sudbury River below the dam at Framingham Reservoir No. 1.

The grounds and structures at all of the reservoirs have been cared for as usual and the lanes along the property lines have been kept open. At the foreman's headquarters on Salem End Road additional garage facilities are being provided.

The ironwork of the Fountain Street bridge over Reservoir No. 2 was thoroughly cleaned and painted, and the portion of Fountain Street maintained by the Division was repaired to match the adjoining portion of the street which is maintained by the town of Framingham. As the bridge has been in service since 1879 the ironwork was carefully measured in connection with these repairs so that its strength can be calculated to see if it is safe for present-day traffic.

At Whitehall Reservoir the width of the wasteway in the lower dam below Wood Street was widened from 4 to 8 feet, and side walls were built along the brook channel for a distance of 100 feet below Wood Street. In November and December the town of Hopkinton pumped about 400,000 gallons of water from the reservoir to supplement its regular supply.

Farm Pond.

No water has been used by the Metropolitan Water District from Farm Pond since it was acquired from the city of Boston January 1, 1898. It was last used as a source of water supply by the city in September, 1892, and some water was also drawn from the pond in June of that year to replenish the supply in Lake Cochituate. No water was turned into the pond from an outside source and no water was wasted from the pond this year and its elevation did not vary more than 1 foot from the usual high-water line. No water has been let into the pond from the Sudbury Aqueduct since June 26, 1918, and none has been let out of the pond at the sluiceway in the dike since February, 1903. Under rights reserved by legislation the town of Framingham pumped approximately 184,400,000 gallons of water from the filter galleries on the easterly shore of the pond and the railroad companies took approximately 129,600,000 gallons of water directly from the pond for use of locomotives during the year. The Water Division lands and structures at the pond have been given the usual attention.

Lake Cochituate.

Lake Cochituate was kept ready for use in case of emergency but was not used as a source of water supply during the year, although all preparations were made December 12 to draw water from this source if it was found necessary to interrupt the flow in the Sudbury Aqueduct while the "cave-in" over the aqueduct in South Natick was being repaired.

Water was wasted from the lake from January 1 to June 7 and from November 19 to the end of the year. The total quantity wasted was about 5,700,000,000 gallons. The waste was regulated so as to keep the water about one or two feet below high-water line. No water has been diverted from the Sudbury watershed to Lake Cochituate since water was drawn from Framingham Reservoir No. 3 for this purpose in April, 1914.

Brooks and drainage channels and appurtenances have been cleaned and cared for, lanes along property lines have been kept free from brush and sprouts and 3.6 miles of new lanes have been cut along the property line at the northerly end of the lake. The usual care has been taken of grounds and buildings and garage facilities are being increased and made satisfactory for use in cold weather.

Aqueducts.

Wachusett Aqueduct.

Water was drawn from the Wachusett Reservoir through the Wachusett Aqueduct on 299 days. The aqueduct was in use 162 days, 8 hours and 51 minutes and the water drawn, 42,160,700,000 gallons, is equivalent to an average of 115,509,000 gallons a day for the entire year. All of the water was used for generating electric energy at the power station before it entered the aqueduct. At the terminal chamber 76,322,000 gallons of water, equivalent to 209,000 gallons a day, was pumped from the aqueduct by the Westborough State Hospital.

Wire fences were erected on property lines for a distance of 5,583 feet at a cost of 20 cents a foot, exclusive of the posts, which were obtained from Water Division lands.

A drainage ditch was constructed on the northerly side of the open channel in Marlborough for a distance of 575 feet through a swamp, at a cost of $636.32, and brush, grass and weeds were mowed for a distance of 10 miles at a cost of about $250 a mile.

Sudbury Aqueduct.

Water was drawn from Framingham Reservoir No. 3 through the Sudbury Aqueduct continuously, with the exception that on December 12 water was shut off from 11.30 A.M. to 8.30 P.M. in connection with a "cave-in" over the aqueduct at Union Street in South Natick.

Of the 25,140,500,000 gallons of water drawn from the reservoir, about 190,900,000 gallons were pumped from the aqueduct by the town of Framingham to supplement its supply from the filter galleries at Farm Pond, about 4,000,000 gallons were wasted in connection with the examination of the interior of the aqueduct at Union Street in South Natick, and 24,945,600,000 gallons, equivalent to an average of 68,344,110 gallons per day, were delivered into Chestnut Hill Reservoir.

On December 9, following the heavy rainfall of November 26 to 30, with a precipitation of 4 inches, a large settlement occurred in the ground over the aqueduct at Union Street, South Natick. An interior examination of the aqueduct showed that it was not damaged and apparently is in the same condition as when built in 1875. The cavity resulting from the settlement was filled with clean gravel.

The usual work of disposing of brush, grass and weeds along the aqueduct, painting ironwork, cleaning culverts, repairing fences and caring for the lands and structures has been done.

Weston Aqueduct.

Water was drawn from the Sudbury Reservoir into the Weston Aqueduct on 303 days and the aqueduct was in use for 201 days, 22 hours and 30 minutes.

Of the 18,992,500,000 gallons of water drawn from the reservoir, 16,247,400,000 gallons, equivalent to an average of 44,513,425 gallons a day, were delivered into the Weston Reservoir and 2,745,100,000 gallons were diverted at the head house into Framingham Reservoir No. 3.

The aqueduct lands and buildings and the fences, culverts and other appurtenances, have received the usual care and attention, and new stop-planks were provided for use at the head house.

Cochituate Aqueduct.

The Cochituate Aqueduct was not used during the year but has been kept ready for use in case of emergency. The grass, brush and weeds have been mowed on the aqueduct lands, ironwork has been painted, fences and structures on the line of the aqueduct have been repaired where necessary and culverts have been kept open.

Protection of the Water Supply.

A sanitary inspector, two watershed inspectors and three watchmen were employed to examine the condition of premises on the watersheds and prevent pollution of the water in the reservoirs.

Filters have been maintained at Sterling, Sterling Junction, West Boylston, Marlborough and Natick to prevent pollution entering the water supply at these places. During large flows all surface water in excess of the capacity of the filters at Sterling, Marlborough and Natick was sterilized with calcium hypochlorite.

The swamp drainage ditches, which have a total length of 36.78 miles, were cleaned and kept in repair to improve the quality of the water.

The work of improving the portion of Gates Brook, located in the part of West Boylston known as the "Settlement," which was begun in 1915 and was suspended on account of unfavorable conditions during 1918, 1919 and 1920, was completed during 1921. The work done the past year includes 3 concrete culverts and 3 concrete headwalls, 3 brick manholes, 501 feet of open channel with board bottom, 695 feet of 24-inch vitrified pipe and iron pipe drain and the erection of 4,844 feet of wire fence, and cost $8,400.84.

Wire fences were built on property lines on the easterly side of Big Crane Swamp, in Northborough and Westborough, for a distance of 5,756 feet, to keep cattle in adjoining pastures out of the drainage ditches.

A parcel of woodland on the Stillwater River in Sterling, containing about 11 acres, was purchased of Agnes I. Griffin for additional protection of the water supply.

Clinton Sewage Disposal Works.

Works for disposing of the sewage of the town of Clinton have been operated as required by chapter 557 of the Acts of 1898.

From January 19 to February 7, inclusive, and May 3 to 10, inclusive, the flow in the intercepting sewer exceeded the capacity of the pump, and from November 29 to December 2, inclusive, no electric energy was available for operating the pump because the transmission line was broken by the ice which formed during a severe sleet storm. During these periods the sewage overflowed into the Nashua River and was diluted with sufficient water discharged from the Wachusett Reservoir to prevent objectionable conditions. The pumping station statistics are as follows: —

Total pumpage (gallons)	429,352,000
Average for the year (gallons per day)	1,176,000
Electric energy used (kilowatt hours)	148,305
Pumpage per kilowatt hour (gallons)	2,895
Average lift (feet)	49.7
Efficiency of pumping unit, including energy lost in transmission and in heating station (per cent)	50.2
Coal used for burning sludge (pounds)	41,995
Cost of pumping:	
Labor	$2,051 86
Electric energy	786 02
Coal for burning sludge	157 54
Repairs and supplies	827 99
Total	$3,823 41
Cost per million gallons	$8.905
Cost per million foot gallons	.179

Electric heating apparatus was installed in the engine room at a cost of $622.02, in place of the steam-heating apparatus abandoned in 1920 in connection with the disposal of the old steam pumping plant.

The cost of filtration has been as follows: —

Labor	$8,050 60
Supplies and expenses	1,283 94
Total	$9,334 54
Cost per million gallons	$21.741

For several years the quantity of sewage to be disposed of has exceeded the efficient capacity of the filters, so that it was necessary to operate them continuously instead of intermittently most of the time. The resulting incomplete purification clogged the filters, so that this year it was necessary to dispose of the sewage by irrigation on the water works lands adjoining the filters while they were being drained and scraped and prepared for winter service.

Forestry.

The year's planting includes 81,900 pine seedlings on Wachusett lands, 47,600 on Sudbury lands, 9,600 along the Sudbury and Cochituate aqueducts and 20,800 pine seedlings and 5,000 Norway

spruce seedlings set out on Sudbury lands to fill in previous plantings.

Objectionable growths which were interfering with the growth of the seedlings have been cut from 76 acres of planted land in the Wachusett section, and from about 100 acres in the Sudbury section.

Brush, grass and weeds were mowed for a width of 40 feet along 16 miles of fire guard, for a width of 15 to 45 feet along 36 miles of forest roads, and for a width of 100 feet along 12 miles of main highways in the Wachusett and Sudbury sections.

Diseased chestnut trees were cut from about 12 acres of Wachusett lands by the Water Division forces, and from about 14 acres of Sudbury land at Whitehall Reservoir by the Howe Lumber Company, which purchased the timber for $1,600.

Work of destroying the gypsy moth, pine-tree weevil and other insects has been undertaken so far as practicable with the resources available, and about $11,000 was expended for this work by the Division.

The work undertaken in 1920 to prolong the life of the fine row of English elm trees along Beacon Street at the Chestnut Hill Reservoir has been continued, and $2,641.13 was expended on this work during the year.

An unusual storm which began in the early afternoon of Saturday, November 26, and ended about noon Tuesday, November 29, consisting of rain, sleet, hail and snow, caused damage which is beyond description to trees and shrubs over all of the water works lands. Nothing like it has previously occurred in the history of the works. Many branches and even large limbs were broken off by the weight of the heavy coating of ice which formed on them, leaving the growth which has not been cut off with scars that will remain for many years.

The total expenditure during the year chargeable to forestry is $34,966.70.

Hydro-electric Service.

During the year 16,079,148 kilowatt hours of electric energy were delivered from the hydro-electric stations operated by the water drawn from the Wachusett and Sudbury reservoirs. The total value of this energy at contract prices, including rentals of $139 for transmission line locations, is $90,106.13. The total expense charged to operation of both stations and transmission lines is $54,537.94,

leaving a profit from the operation of the stations of $35,568.19, equivalent to $2.212 per thousand kilowatt hours. Of the total energy delivered from both stations this year, 1,747,100 kilowatt hours of energy, for which $10,028.85 was received, were generated with water wasted from the reservoirs and not required for water supply.

Wachusett Service.

On account of delay in receiving the new casting the work of repairing turbine No. 4, which was in progress last year, was not completed until November 22. The expenditure this year in connection with the repairs is $1,090.43.

At a cost of $1,251.58 an emergency control gallery with three approaches has been installed in the head-gate room over the aqueduct and separated from the generator room by a brick wall 12 inches in thickness. From the gallery the hydraulic valves controlling the flow of water to all of the turbines can be operated, the positions of the valves being shown at all times by electric lights.

A modern open system governing equipment, including four Type T governors for the main turbines, a Type F governor for one of the exciter turbines, and a central pumping plant to furnish power for operation, was purchased of the Lombard Governor Company, and the work of installing the equipment in place of the old unreliable closed system governing equipment is now in progress. The total expenditure on account of the work was $8,385 at the close of the year.

On account of the damage to the New England Power Company's lines and to the overhead portions of the Water Division 13,800-volt connecting lines, caused by the weight of the ice coating which formed on the lines during the unusual storm of November 26 to 29, the regular operation of the Wachusett power station was interrupted for several days while the lines were being repaired.

The Water Division's 13,800-volt line failed on November 28 and was repaired on the 29th, but during this interruption some energy was delivered from the power station over the 2,300-volt line for operating the Clinton sewerage pumping station and lighting a section of the town of Clinton. The 66,000-volt transmission line was not injured, but could not be used until December 1 because of failure of connecting lines.

The Wachusett power station was operated on 300 days. The statistics for the year 1921 are as follows: —

Total energy developed (kilowatt hours)			10,001,900
Energy used at power station (kilowatt hours)			17,743
Available energy (kilowatt hours)			9,984,157
Water used (gallons)			46,735,900,000
Average head (feet)			96.7
Energy developed per million foot gallons (kilowatt hours)			2.213
Efficiency of station (per cent)			70.4
Credits:			
Energy sold New England Power Company and Edison Electric Illuminating Company, 9,835,852 kilowatt hours at $0.0053		$52,130 02	
Deduction of 2 per cent as provided in contract, 196,717 kilowatt hours at $0.0053		1,042 60	
		$51,087 42	
Energy furnished Clinton sewerage pumping station, 148,305 kilowatt hours at $0.0053		786 02	
Rental, transmission line location		139 00	
			$52,012 44
Charges:			
Superintendence		$1,783 00	
Labor, operating station		10,688 32	
Repairs and supplies:			
Power station	$7,411 52		
Transmission line	93 99		
		7,505 51	
		$19,976 83	
Taxes		3,250 00	
Administration, general supervision, interest and sinking fund		10,116 39	
			33,343 22
Profit			$18,669 22
Cost of available energy per thousand kilowatt hours			$3.340

Sudbury Service.

The hydro-electric station at the Sudbury Dam in Southborough was operated on 301 days. With the exception of 189,000,000 gallons by-passed under turbine No. 1, November 28 to December 1, for water supply when the electric companies' lines were crippled by ice and they were unable to take energy from the station, and

57,000,000 gallons wasted at the overflow on May 1, all the water drawn from the Sudbury Reservoir was used to generate energy.

During the year 6,383,000,000 gallons of water not required for water supply were utilized for generating 809,700 kilowatt hours of energy, which was sold for $5,060.63.

Several new turbine bearings were installed, all the machinery below the floor was scraped and painted with red lead and the slip rings on No. 3 generator were resurfaced.

On December 1 and 2 energy was supplied from the Sudbury power station to the New England Power Company to maintain the electric service in Marlborough, because of the damage to the companies' transmission lines by ice.

The Sudbury hydro-electric statistics for 1921 are as follows: —

Total energy developed (kilowatt hours)		6,105,130
Energy used at power station (kilowatt hours)		10,139
Available energy (kilowatt hours)		6,094,991
Framingham Reservoir No. 3 service:		
Water used (gallons)		28,848,400,000
Average head (feet)		65.5
Weston Aqueduct service:		
Water used (gallons)		18,803,500,000
Average head (feet)		37.4
Energy developed per million foot gallons (kilowatt hours)		2.355
Efficiency of station (per cent)		75.0
Credits:		
Energy sold Edison Electric Illuminating Company of Boston, 6,094,991 kilowatt hours, at $0.00625		$38,093 69
Charges:		
Superintendence	$1,562 90	
Labor, operating station	11,249 60	
Repairs and supplies	1,354 40	
	$14,166 90	
Taxes	1,605 80	
Administration, general supervision, interest and sinking fund	5,422 02	
		21,194 72
Profit		$16,898 97
Cost of available energy per thousand kilowatt hours		$3.477

Distribution Pumping Stations.

The total quantity of water pumped at the five distribution pumping stations during the year was 29,428,510,000 gallons, 3,216,270,000 gallons, or 9.85 per cent less than the quantity pumped in 1920. Of the total quantity of water supplied the Metropolitan Water District in 1921, about 68 per cent was pumped for the northern low, high and extra high services and the southern low service, and $^{65}/_{100}$ per cent was repumped for the southern extra high service.

The total cost of operating all the pumping stations for the year 1921 was $240,720.70. Compared with the previous year there is an increase of about $6,400 for operating labor, an increase of about $4,500 for fuel, a decrease of about $19,700 for repairs, and a decrease of about $600 for miscellaneous supplies, making a total decrease of about $9,400.

Fuel.

At the beginning of the year there were 2,540 net tons of bituminous coal and 1,825 net tons of anthracite screenings on hand at the pumping stations. During the year 7,792 net tons of bituminous coal and 2,370 net tons of anthracite screenings were purchased. At the close of the year 2,515 net tons of bituminous coal and 655 net tons of anthracite screenings are on hand at the pumping stations.

During the early part of the year 1,783 net tons of bituminous coal were purchased from the New England Fuel and Supply Company for $3.50 to $5.60 per ton at the mines, 420 net tons were purchased from the Andersen Coal Sales Company for $3.10 to $5 per ton at the mines, and 127 net tons were purchased from the Lehigh Valley Coal Sales Company for $3.25 to $3.85 per ton at the mines.

The remainder of the bituminous coal for the Chestnut Hill, Arlington and Hyde Park stations, amounting to 4,747 net tons, was purchased of the William A. Jepson Corporation at a base price of $3.75 a net ton at the mines for 14,550 heat units per pound of dry coal, and in case of variation in quality a corresponding variation was made in the price of the coal.

Beginning May 4 the bituminous coal for the Spot Pond station was purchased of the Locke Coal Company, 399 net tons being purchased prior to October 1 for $9.25 per ton delivered in the bins and 316 net tons were purchased after October 1 for $9.65 per ton delivered in the bins.

Of the 2,370 net tons of anthracite screenings purchased, 752 tons were furnished by the New England Fuel and Supply Company for $2.59 per ton at the mines, and 1,618 tons were purchased from local coal yards for $3.95 to $5.50 per ton.

Pumping Statistics.

The pumping statistics for the various stations are as follows: —

Station No. 1.

Pumpage and Duty.

	Engines Nos. 1 and 2.	Engine No. 3.	Engine No. 4.	Totals.
Pumping capacity (million gallons per day)	16	20	30	66
Pumping time (engine hours)	4,936.92	11.00	133.75	5,081.67
Pumpage, total (million gallons)[1]	1,554.87	9.51	152.54	1,716.92
Pumpage, average daily (gallons)[1]	4,260,000	26,000	418,000	4,704,000
Lift, average (feet)	132.56	127.35	127.43	132.08
Coal used:				
Bituminous (pounds)	–	–	–	2,673,670
Anthracite screenings (pounds)	–	–	–	1,326,496
Duty, average (foot pounds per 100 pounds coal)	–	–	–	47,220,000

[1] Corrected for slip.

Cost of Pumping.

	Totals.	Per Million Gallons.	Per Million Foot Gallons.	Electric Equivalent per Kilowatt Hour.
			Cents.	Cents.
Labor (operation and superintendence)	$21,055 14	$12 26	9.28	2.95
Fuel	18,282 59	10 65	8.06	2.57
Repairs	4,928 17	2 87	2.17	.69
Oil, waste and packing	597 15	35	.27	.09
Miscellaneous supplies	701 47	41	.31	.10
Totals	$45,564 52	$26 54	20.09	6.40
Administration, general supervision, interest and sinking fund.	36,904 48	21 49	16.27	5.18

Station No. 2.

Pumpage and Duty.

	Engines Nos. 5, 6 and 7.	Engine No. 12.	Totals.
Pumping capacity (million gallons per day)	105	40	145
Pumping time (engine hours)	10,896.80	8,734.33	19,631.13
Pumpage, total (million gallons)[1]	10,595.77	13,329.04	23,924.81
Pumpage, average daily (gallons)[1]	29,029,000	36,518,000	65,547,000
Lift, average (feet)	30.16	122.61	81.67
Coal used:			
Bituminous (pounds)	–	–	9,647,269
Anthracite screenings (pounds)	–	–	3,647,160
Duty, average (foot pounds per 100 pounds coal)	–	–	122,430,000

[1] Corrected for slip.

Cost of Pumping.

	Totals.	Per Million Gallons.	Per Million Foot Gallons.	Electric Equivalent per Kilowatt Hour.
			Cents.	Cents.
Labor (operation and superintendence)	$52,003 49	$2 17	2.66	.85
Fuel	60,059 87	2 51	3.07	.98
Repairs	12,845 01	54	.66	.21
Oil, waste and packing	1,416 44	06	.07	.02
Miscellaneous supplies	1,101 15	05	.06	.02
Totals	$127,425 96	$5 33	6.52	2.08
Administration, general supervision, interest and sinking fund.	34,713 00	1 45	1.78	0.57

Spot Pond Station.

Pumpage and Duty.

	Engine No. 8.	Engine No. 9.	Totals.
Pumping capacity (million gallons per day)	10	20	30
Pumping time (engine hours)	83.83	3,588.25	3,672.08
Pumpage, total (million gallons)[1]	34.19	3,121.44	3,155.63
Pumpage, average daily (gallons)[1]	94,000	8,552,000	8,646,000
Lift, average (feet)	123.62	133.11	133.01
Coal used:			
Bituminous (pounds)	1,873,980	21,319	1,895,299
Anthracite screenings (pounds)	1,378,696	17,583	1,396,279
Duty, average (foot-pounds per 100 pounds coal)	90,500,000	106,410,000	106,220,000

[1] Corrected for slip.

Cost of Pumping.

	Totals.	Per Million Gallons.	Per Million Foot Gallons.	Electric Equivalent per Kilowatt Hour.
			Cents.	Cents.
Labor (operation and superintendence)	$16,696 90	$5 29	3.98	1.27
Fuel	15,205 17	4 82	3.62	1.15
Repairs	2,728 43	87	.65	.21
Oil, waste and packing	820 53	26	.20	.06
Miscellaneous supplies	482 54	15	.11	.04
Totals	$35,933 57	$11 39	8.56	2.73
Administration, general supervision, interest and sinking fund.	16,558 94	5 25	3.95	1.26

Arlington Station.

Pumpage and Duty.

	Engine No. 10.	Engine No. 11.	Engine No. 15.	Totals.
Pumping capacity (million gallons per day)	1.5	1.5	3.0	6.0
Pumping time (engine hours)	7,389.33	94.25	104.75	7,588.33
Pumpage, total (million gallons)[1]	340.54	7.49	3.37	351.40
Pumpage, average daily (gallons)[1]	933,000	21,000	9,000	963,000
Lift, average (feet)	281.41	300.69	96.29	281.91
Coal used:				
Bituminous (pounds)	837,565	21,700	32,080	891,345
Anthracite screenings (pounds)	536,055	945	5,295	542,295
Duty, average (foot-pounds per 100 pounds coal)	58,120,000	37,260,000	49,400,000	57,560,000

[1] Corrected for slip.

Cost of Pumping.

	Totals.	Per Million Gallons.	Per Million Foot Gallons.	Electric Equivalent per Kilowatt Hour.
			Cents.	Cents.
Labor (operation and superintendence)	$11,374 21	$32 37	11.48	3.66
Fuel	5,717 94	16 27	5.77	1.84
Repairs	1,384 61	3 94	1.40	.45
Oil, waste and packing	260 05	74	.26	.08
Miscellaneous supplies	292 22	83	.30	.09
Totals	$19,029 03	$54 15	19.21	6.12
Administration, general supervision, interest and sinking fund.	5,941 17	16 91	6.00	1.91

Hyde Park Station.

Pumpage and Duty.

	Engine No. 13.	Engine No. 14.	Totals.
Pumping capacity (million gallons per day)	3	3	6
Pumping time (engine hours)	2,898.42	1,930.25	4,828.67
Pumpage, total (million gallons)[1]	158.84	120.91	279.75
Pumpage, average daily (gallons)[1]	435,000	331,000	766,000
Lift, average (feet)	138.12	138.74	138.39
Coal used:			
Bituminous (pounds)	178,456	129,111	307,567
Anthracite screenings (pounds)	232,110	163,326	395,436
Duty, average (foot-pounds per 100 pounds coal)	44,510,000	47,780,000	45,870,000

[1] Corrected for slip.

Cost of Pumping.

	Totals.	Per Million Gallons.	Per Million Foot Gallons.	Electric Equivalent per Kilowatt Hour.
			Cents.	Cents.
Labor (operation and superintendence)	$9,265 49	$33 12	23.93	7.62
Fuel	2,340 98	8 37	6.05	1.93
Repairs	585 94	2 10	1.52	.48
Oil, waste and packing	202 73	72	.52	.16
Miscellaneous supplies	372 48	1 33	.96	.31
Totals	$12,767 62	$45 64	32.98	10.50
Administration, general supervision, interest and sinking fund.	4,918 40	17 58	12.70	4.04

Distribution Reservoirs.

The locations, elevations and capacities of the distribution reservoirs of the Metropolitan Water Works are shown by the following table: —

Distribution Reservoirs and Locations.	Elevation of High Water.[1]	Capacity in Gallons.
Low service:		
Spot Pond, Stoneham and Medford	163.00	1,791,700,000
Chestnut Hill Reservoir, Brighton district of Boston	134.00	300,000,000
Weston Reservoir, Weston	200.00	200,000,000
Mystic Reservoir, Medford	157.00	26,200,000
Northern High Service:		
Fells Reservoir, Stoneham	271.00	41,400,000
Bear Hill Reservoir, Stoneham	300.00	2,450,000
Northern Extra High Service:		
Arlington Standpipe, Arlington	442.00	550,000
Southern High Service:		
Fisher Hill Reservoir, Brookline	251.00	15,500,000
Waban Hill Reservoir, Newton	264.50	13,500,000
Forbes Hill Reservoir, Quincy	192.00	5,100,000
Forbes Hill Standpipe, Quincy	251.00	330,000
Southern Extra High Service:		
Bellevue Reservoir steel tank, West Roxbury district of Boston	375.00	2,500,000
Total	–	2,399,230,000

[1] Elevation in feet above Boston city base.

By arrangement with the city of Chelsea a portion of the maintenance of its reservoir on Powder Horn Hill is assumed by the Metropolitan Water Works, and the reservoir is used when necessary in connection with the northern high-service supply. The reservoir has a capacity of 1,000,000 gallons with high-water line at elevation 196.6. The reservoir was in service from January 6 to April 13, and from December 23 to 31, and was kept full of water during the remainder of the year for use in case of emergency.

By arrangement with the city of Malden its standpipe on Waitt's Mount, with a capacity of 1,120,000 gallons to high-water line at elevation 250, is maintained by the Division. It has been kept full of water and was used for emergency supply on January 6 and 7 while a break in the 36-inch northern high-service supply main in Fellsway East was being repaired.

The lands, trees, shrubs and structures at all of the distribution reservoirs have been cared for as usual, gates and screens have been operated as required and buildings have been repaired and painted where necessary.

Distribution Pipe Lines.

The length of the distribution pipe lines owned and operated at the close of the year is 126.22 miles.

The pipe lines have been patrolled and the work of municipalities, public service corporations and other parties in any way affecting the lines has been inspected. The valves, valve chambers and other appurtenances have been kept in good condition and salt was placed on covers of important valves to keep them free from ice during cold weather.

The two meter register chambers at Cleveland Circle in Brighton were relocated in connection with the rebuilding of the streets, and the meter register chamber at Harvard Street at the Brookline–Boston boundary line was relocated in connection with the construction of a garage.

A 20-inch Venturi meter with 10-inch throat was installed at the connection with the city of Newton main in Ward Street at Hammond Street, to measure water pumped by the city from the Metropolitan water main.

A 24-inch check valve was installed in Beale Street at Adams Street in Quincy and changes were made in the connection with the city main on Beale Street at Summit Avenue, so that the city now has two independent metered connections and the head lost by friction has been materially reduced.

The steelwork of the pipe bridges at Walnut Street in Somerville; Massachusetts Avenue in Cambridge and College Avenue in Medford was cleaned and painted two coats of red lead.

There are now 72 Venturi meters from 6 to 60 inches in diameter in the distribution pipe lines. Sixty-three of these, and 12 smaller Disc, Torrent and Detector meters, and 3 Union and 1 Crown meter owned by the town of Milton, and 1 Detector meter owned by the city of Malden, are regularly used for measuring the water supplied to the various cities and towns.

The nine pressure regulating valves in the distribution mains for reducing the pressure of the water supplied to Nahant, Revere, Swampscott and Winthrop and to portions of Chelsea, East Boston and Hyde Park have given satisfactory service.

Recording pressure gages have been maintained at 21 stations on the distribution system and tables in the Appendix show the

hydraulic grade at 18 of these stations as determined from the charts.

A break occurred in the 36-inch northern high-service main in Fellsway East in Malden about 9.15 P.M., January 6, from which about 2,000,000 gallons of water escaped before the line was shut off, and caused considerable damage in the street but did no injury to private property. Repairs were completed and the line was in service again at 7 P.M., January 7. The cost of the repairs was $992.98.

In June seven lead-joint leaks were repaired in the 36-inch submerged pipe lines under the Mystic River at Wellington bridge in Somerville, and one was repaired in the 36-inch submerged pipe lines under the Charles River at Magazine Street in Cambridge. A scow and diver were used in repairing these leaks and the total cost of the work was $1,671.10.

In July a cracked 48-inch pipe was removed from one of the low-service mains in front of Chestnut Hill pumping station No. 2 and a sound pipe laid at a cost of $451.88.

Leaks at 6 defective wooden joints were repaired at a cost of $215.50 and 33 other leaks were repaired during the year at a cost of $1,251.89. Of these, 30 were at lead joints.

A complete stock of pipes, specials and other materials and supplies required for maintaining and operating the pipe lines has been kept on hand at the Glenwood pipe yard in Medford and at the Chestnut Hill pipe yard in Brighton, and an auto truck equipped with a gate-operating attachment has been stationed at each yard with men on duty ready to operate them in case of emergency at any time during the day or night.

Consumption of Water.

During the year 42,853,711,000 gallons of water were furnished to the 18 cities and towns supplied in the Metropolitan Water District. This is equivalent to an average daily consumption of 117,407,400 gallons, and, for the estimated population of 1,239,740, is at the rate of 95 gallons per capita per day, and compared with a per capita use of 105 gallons per day in 1920 shows a reduction of nearly 10 per cent.

The population, consumption of water and per cent of services metered in the Metropolitan Water District as supplied in 1921, and

for the period from 1890 to 1921, inclusive, are shown graphically by the accompanying diagram.

The average daily consumption of water in each of the municipalities in the Metropolitan Water District supplied during 1920 and 1921, as measured by the Metropolitan Water Works meters, is as follows: —

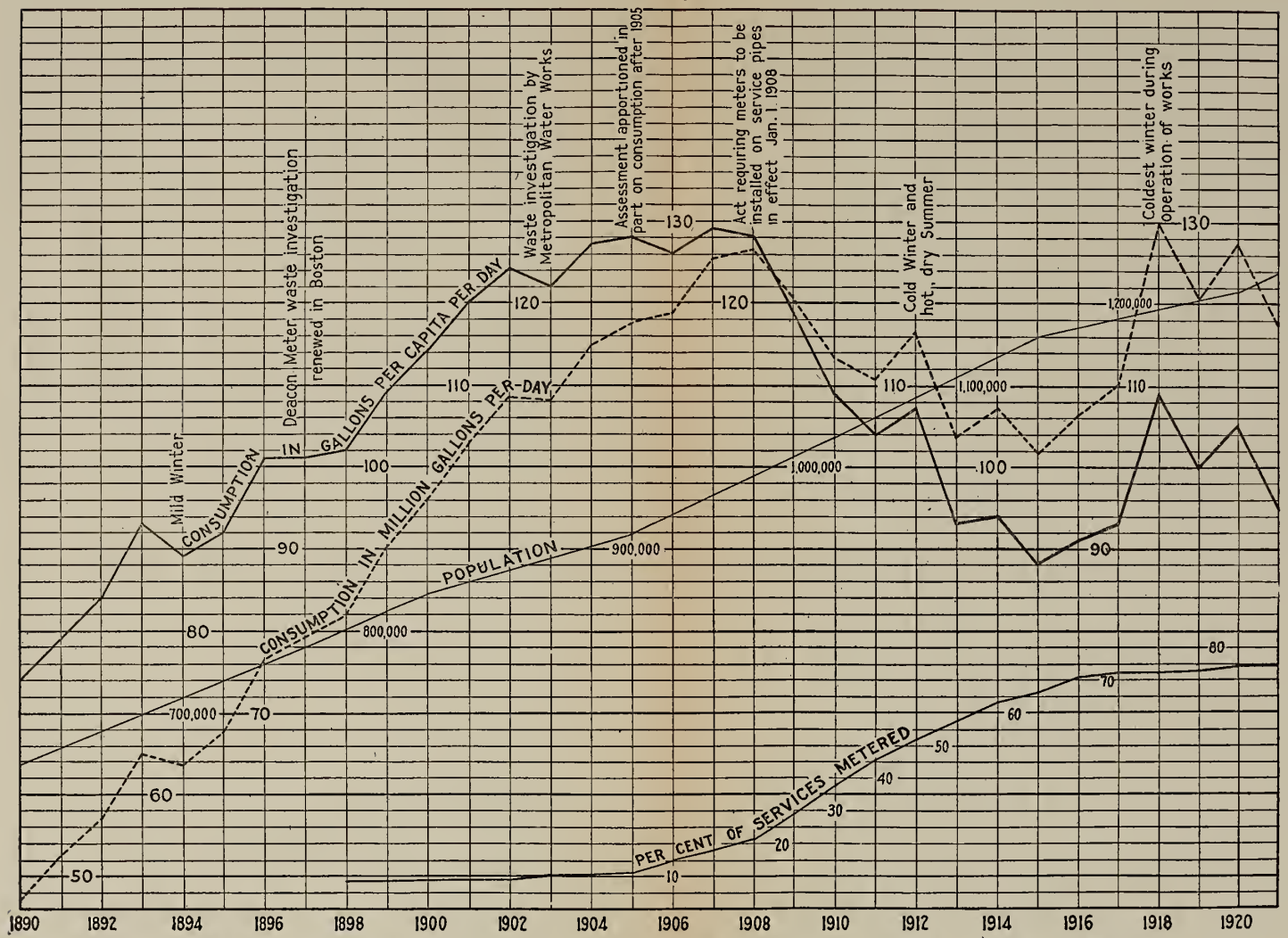
	Estimated Population, 1921.	Average Daily Consumption.				
		1920.		1921.		Decrease in Gallons.
		Gallons.	Gallons per Capita.	Gallons.	Gallons per Capita.	
Arlington	19,210	1,055,600	56	1,100,300	57	44,700 [1]
Belmont	11,390	591,400	54	678,300	60	86,900 [1]
Boston	766,800	94,297,400	125	85,609,200	112	8,688,200
Chelsea	44,180	3,316,400	76	3,101,300	70	215,100
Everett	41,290	3,455,200	86	3,530,600	86	75,400 [1]
Lexington	6,540	424,300	66	441,700	68	17,400 [1]
Malden	50,350	2,793,300	57	2,468,700	49	324,600
Medford	41,130	1,739,700	44	1,853,900	45	114,200 [1]
Melrose	18,550	1,108,100	61	1,064,700	57	43,400
Milton	9,560	430,900	46	402,500	42	28,400
Nahant	1,380	192,600	145	182,100	132	10,500
Quincy	49,460	4,472,500	93	4,269,500	86	203,000
Revere	30,340	1,975,900	68	1,958,600	65	17,300
Somerville	95,310	7,177,300	77	6,919,400	73	257,900
Stoneham	7,980	789,600	100	610,400	76	179,200
Swampscott	8,350	657,200	81	718,800	86	61,600 [1]
Watertown	21,800	1,911,700	89	1,624,400	75	287,300
Winthrop	16,120	876,400	56	873,000	54	3,400
District	1,239,740	127,265,500	105	117,407,400	95	9,858,100

[1] Increase.

During 1921 there was a decrease in consumption as compared with 1920 in two-thirds of the municipalities supplied, a decrease for the entire district supplied of nearly 10,000,000 gallons a day, and a decrease in the per capita consumption of 10 gallons per day. The consumption by districts in 1921 as compared with 1920 is as follows: —

POPULATION, CONSUMPTION OF WATER AND PER CENT OF SERVICES METERED IN THE METROPOLITAN WATER DISTRICT AS SUPPLIED IN 1921

FROM 1890 TO 1921



Note: Estimated population and consumption per capita given on diagram published in annual reports 1916 to 1919 inclusive have been revised and are here shown in accordance with 1920 census.

	Gallons per Day, 1921.	Decrease from 1920.	
		Gallons per Day.	Percentage.
Southern low-service district, embracing the low-service district of Boston, with the exception of Charlestown and East Boston	38,854,100	6,717,300	14.48
Northern low-service district, embracing the low-service districts of Somerville, Chelsea, Malden, Medford, Everett, Arlington, Charlestown and East Boston	24,838,400	1,344,500	5.14
Southern high-service district, embracing Quincy and Watertown, the high-service districts of Boston, and portions of Belmont and Milton	42,646,100	1,629,800	3.68
Northern high-service district, embracing Melrose, Revere, Winthrop, Swampscott, Nahant and Stoneham, and the high-service districts of Somerville, Chelsea, Malden, Medford, Everett and East Boston	9,308,400	293,100	3.05
Southern extra high-service district, embracing the higher portions of Hyde Park, Milton and West Roxbury	773,600	36,800[1]	4.99[1]
Northern extra high-service district, embracing Lexington and the higher portions of Arlington and Belmont	986,800	89,800[1]	10.01[1]
Totals	117,407,400	9,858,100	7.91

[1] Increase.

Installation of Meters on Service Pipes.

Information regarding the installation of meters on service pipes by the municipalities supplied with water from the Metropolitan Water Works is given in the accompanying table.

City or Town.	Services in use Dec. 31, 1907.	Services equipped with Meters Dec. 31, 1907.	Number of Meters required to be set on Old Services Each Year.	Old Services in use Dec. 31, 1921.	Old Services equipped with Meters Dec. 31, 1921.	Meters Set on Old Services 1908–1921, inclusive.	Number of Meters required to be set on Old Services 1908–1921, inclusive.	New Services installed and in use Dec. 31, 1921.[1]	New Services equipped with Meters Dec. 31, 1921.[1]	Total Services in use Dec. 31, 1921.	Total Services equipped with Meters Dec. 31, 1921.	Per Cent of Services metered Dec. 31, 1921.
Arlington	1,929	835	55	1,798	1,798	963	770	1,626	1,626	3,424	3,424	100.00
Belmont	792	792	–	752	752	–	–	1,286	1,286	2,038	2,038	100.00
Boston	93,942	5,190	4,276	90,640	56,561	51,371	51,108[2]	16,975	14,127	107,615	70,688	65.69
Chelsea	6,603	1,792	140	3,357[3]	3,330	1,538	1,960	1,936	1,928	5,293	5,258	99.34
Everett	5,161	116	252	5,152	3,640	3,524	3,528	1,013	1,013	6,165	4,653	75.47
Lexington	730	80	32	743	730	650	448	669	669	1,412	1,399	99.08
Malden	7,055	6,780	14	6,989	6,930	150	196	1,540	1,345	8,529	8,275	97.02
Medford	4,378	582	179	4,073	4,073	3,491	2,506	3,019	3,019	7,092	7,092	100.00
Melrose	3,429	1,058	119	3,429	3,429	2,371	1,666	967	898	4,336	4,327	99.79
Milton	1,285	1,285	–	1,263	1,263	–	–	1,033	1,033	2,296	2,296	100.00
Nahant	410	90	16	407	310	220	224	366	282	773	592	76.58
Quincy	6,091	1,480	230	5,877	5,286	3,806	3,220	5,474	5,048	11,351	10,334	91.04
Revere	2,875	158	138	2,844	1,980	1,822	1,932	2,069	2,069	4,913	4,049	82.41
Somerville	11,662	3,446	411	11,407	9,140	5,694	5,754	2,276	2,180	13,683	11,320	82.73
Stoneham	1,331	30	65	1,320	1,318	1,288	910	390	364	1,710	1,682	98.36
Swampscott	1,307	892	21	1,259	1,259	367	294	754	754	2,013	2,013	100.00
Watertown	1,886	1,886	–	1,886	1,886	–	–	1,665	1,665	3,551	3,551	100.00
Winthrop	2,074	70	100	2,033	2,019	1,949	1,400	1,027	1,027	3,060	3,046	99.54
Totals	152,940	26,562	6,048	145,229	105,704	79,204	75,916	44,025	40,333	189,254	146,037	77.16

[1] The number of new services installed and the number of new services equipped with meters do not always agree for the reason that service pipes are installed but meters are not set until the buildings are permanently occupied.

[2] Boston: Number of meters required to be set each year on old services, 4,438 for 1908, 1909 and 1910; reduced to 4,225 in 1911 on account of reduction in number of old services and increased to 4,276 after 1911 on account of unmetered services acquired by the annexation of Hyde Park. Boston exempt from setting meters on old services in 1917 and 1918. (Chapter 269, Special Acts of 1917, and Chapter 45, Special Acts of 1918.)

[3] Chelsea: 2,810 services destroyed during conflagration in April, 1908; 987 metered services remained after conflagration.

Water supplied Outside of Metropolitan Water District.

During the year 485,696,000 gallons of water were supplied from the Metropolitan Water Works for use outside the Metropolitan Water District, for which $9,307.48 was charged, as follows: —

Places supplied.	Total Quantity (Gallons).	Average Quantity (Gallons per Day).	Number of Days on which Water was supplied.	Amounts charged for Water supplied.
Westborough State Hospital	76,322,000	209,000	365	$2,289 66
Town of Framingham:				
From Sudbury Aqueduct	190,900,000	523,014	365	4,581 60
From Filter-gallery at Farm Pond	184,400,000	505,205	365	353 64
United States government:				
Peddock's Island	22,066,000	60,500	365	1,380 58
Portion of town of Saugus	12,008,000	32,900	365	702 00

Quality of the Water.

The yearly average results of the chemical analyses made by the Department of Health of the Commonwealth since 1892, and of the biological and bacteriological examinations made in the Metropolitan Water Works laboratory of water from the service taps in Boston since 1898, are given in tables in Appendix No. 2.

Engineering.

In addition to making the usual surveys, plans, computations, investigations, estimates, reports and summaries of water works statistics in connection with the maintenance and operation of the works, considerable engineering work has been done in connection with the construction of the additional distribution works required by the growth of the District.

Information and assistance was furnished the Attorney-General's Department in connection with the claim for large damages made against the Commonwealth by the town of Stoneham on account of the taking of Spot Pond in 1898. The hearings in the case were begun April 21 and ended August 11, and the report of the Commis-

sioners, finding that Stoneham suffered no damage, was made December 17.

In the Appendix are tables giving additional information relating to the operation of the Metropolitan Water Works for the year 1921 and the usual water works statistics.

Respectfully submitted,

WILLIAM E. FOSS,
Director and Chief Engineer.

Boston, January 2, 1922.

REPORT OF DIRECTOR AND CHIEF ENGINEER OF SEWERAGE DIVISION.

James A. Bailey, *Commissioner, Metropolitan District Commission.*

Dear Sir: — The following report of the operations of the Metropolitan Sewerage Works for the year ending December 31, 1921, is respectfully submitted: —

Organization.

The Director and Chief Engineer has charge of the design and construction of all new works, and of the maintenance and operation of all the works controlled by the Metropolitan District Commission for removing sewage from the twenty-six municipalities which comprise the Metropolitan Sewerage Districts.

The following assistants have been employed during the year: —

Henry T. Stiff . . .	Senior Assistant Engineer, in charge of office and drafting room and of the construction work.
Clarence A. Moore . . .	Assistant Engineer, in charge of maintenance studies and records and of construction work on the North Metropolitan System.
George W. Wood . . .	Assistant Engineer, in charge of survey work and field work in connection with the Wellesley extension construction.
Ralph W. Loud . . .	Assistant Engineer, in charge of survey work and field work in connection with the Reading extension construction.
Thomas L. Whelan . .	Superintendent, North Metropolitan Sewerage District.
Arthur F. F. Haskell . .	Superintendent, South Metropolitan Sewerage District.

In addition to the above, the number of engineering and other assistants employed during the year was 9, which includes 1 instrumentman, 3 inspectors, 1 draftsman, 2 rodmen and engineering assistants and 2 stenographers.

METROPOLITAN SEWERAGE DISTRICTS.

Areas and Populations.

During the year no changes have been made in the extent of the metropolitan sewerage districts.

The populations of the districts, as given in the following table, are based on the census of 1920.

Table showing Ultimate Contributing Areas and Present Estimated Populations within the Metropolitan Sewerage Districts, as of December 31, 1921.

	City or Town.	Area (Square Miles).		Estimated Population.	
North Metropolitan District.	Arlington	5.20		19,420	
	Belmont	4.66		11,650	
	Boston (portions of)	3.45		97,250	
	Cambridge	6.11		111,580	
	Chelsea	2.24		44,580	
	Everett	3.34		41,760	
	Lexington[1]	5.11		5,020	
	Malden	5.07		50,850	
	Medford	8.35		41,970	
	Melrose	3.73		18,690	
	Reading	9.82		7,670	
	Revere	5.86		30,950	
	Somerville	3.96		96,200	
	Stoneham	5.50		8,020	
	Wakefield	7.65		13,440	
	Winchester	5.95		10,770	
	Winthrop	1.61		16,380	
	Woburn	12.71		16,830	
			100.32		643,030
South Metropolitan District.	Boston (portions of)	24.96		271,500	
	Brookline	6.81		39,230	
	Dedham[1]	9.40		11,100	
	Milton	12.59		9,630	
	Newton	16.88		47,150	
	Quincy	12.56		50,100	
	Waltham	13.63		31,720	
	Watertown	4.04		21,930	
	Wellesley	9.89		6,600	
			110.76		488,960
	Totals		211.08		1,131,990

[1] Part of town.

METROPOLITAN SEWERS.

Sewers Purchased and Constructed and their Connections.

During the year there have been built 0.541 miles of metropolitan sewers within the sewerage districts, so that there are now 118.113 miles of metropolitan sewers. Of this total, 9.642 miles of sewers, with the Quincy pumping station, have been purchased from cities and towns of the districts. The remaining 108.471 miles of sewers and other works have been constructed by the metropolitan boards.

The locations, lengths and sizes of these sewers are given in the following tables, together with other data referring to the public and special connections with the systems: —

North Metropolitan Sewerage System.

Location, Length and Sizes of Sewers, with Public and Special Connections.

City or Town.	Size of Sewers.	Length in Miles.	Public Connections, December 31, 1921.	Special Connections.	
				Character or Location of Connection.	Number in Operation.
Boston: —					
Deer Island	4′ 0″ to 9′ 0″	1.653	4	–	–
East Boston	9′ 0″ to 1′ 0″	5.467	25	Shoe factory	1
				Middlebrook Wool-combing Co.	1
				Navy Yard	9
Charlestown	6′ 7″×7′ 5″ to 1′ 0″	3.292	15	Private building	1
				Club House	1
Winthrop	9′ 0″	2.864	13	Fire department station	1
				Private building	1
				Bakery	1
				Rendering works	1
				Metropolitan Water Works blow-off	1
Chelsea	8′ 4″×9′ 2″ to 15″	5.230	14	Chelsea Water Works blow-offs	2
				Naval Hospital	1
				Metropolitan Water Works blow-off	1
				Cameron Appliance Co.	1
				Shultz-Goodwin Co.	1
Everett	8′ 2″×8′ 10″ to 4′ 8″×5′ 1″	2.925	8	Andrews-Wasgatt Co.	1
				National Metallic Bed Co.	1
				Linoide Co.	1
				Factory	2
				New England Structural Co.	1
Lexington	–	–	1	–	–
Malden	4′ 6″×4′ 10″ to 1′ 0″	5.844[1]	34	Metropolitan Water Works blow-off	1
				Private buildings	195[2]

[1] Includes 1.84 miles of sewer purchased from the city of Malden.

[2] Mostly buildings connected with sewers formerly belonging to city of Malden but later purchased by the Metropolitan Sewerage Commission in accordance with chapter 215 of the Acts of 1898 and by the Metropolitan Water and Sewerage Board in accordance with chapter 512 of the Acts of 1911 and made parts of the North Metropolitan Sewerage System.

NORTH METROPOLITAN SEWERAGE SYSTEM — *Concluded.*

Location, Length and Sizes of Sewers, with Public and Special Connections — Concluded.

City or Town.	Size of Sewers.	Length in Miles.	Public Connections, December 31, 1921.	Special Connections.	
				Character or Location of Connection.	Number in Operation.
Melrose	4′ 6″×4′ 10″ to 10″	6.099[1]	39	Private buildings	117[2]
				Factory	1
				Railroad station	1
				Park Department bath-house	1
				Harvard dormitories	2
				Slaughter house	1
Cambridge	5′ 2″×5′ 9″ to 1′ 3″	7.209	45	City Hospital	3
				Street railway machine shop	1
				Private building	1
				Factory building	1
				Tannery	1
				Slaughterhouses (3)	1
				Carhouse	1
Somerville	6′ 5″×7′ 2″ to 10″	3.577	12	Somerville Water Works blow-off	1
				Street railway power house	1
				Stable	1
				Rendering works	1
				Railroad scale pit	1
				Private building	1
				Armory building	1
Medford	4′ 8″×5′ 1″ to 10″	5.713	26	Private buildings	9
				Stable	1
				Police substation	1
				Tanneries	6
				Private buildings	10
				Gelatine factory	1
				Watch-hand factory	1
Winchester	4′ 6″ to 1′ 3″	9.470	27	Stable	1
				Railroad station	2
				Felt works	1
				Town Hall	1
				Bay State Saw & Tool Co.	1
				Whitney Machine Co.	1
Stoneham	1′ 8″ to 10″	2.333	4	–	–
Woburn	1′ 10″×2′ 4″ to 1′ 3″	0.713	3	Glue factory	3
				Private buildings	165[4]
Arlington	1′ 6″ to 10″	3.520[3]	43	Railroad station	1
				Car-house	3
				Post office	1
Belmont[5]	–	–	3	–	–
Wakefield	3′ 0″ to 2′ 0″×2′ 3″	0.703	1	–	–
Revere	4′ 0″ to 15″	0.136	3	–	–
Reading	–	0.055	1	–	–
		66.803[6]	321		574

[1] Includes .736 of a mile of sewer purchased from the city of Melrose.

[2] Mostly buildings connected with a sewer formerly belonging to the city of Melrose but later purchased by the Metropolitan Sewerage Commission in accordance with chapter 414 of the Acts of 1896 and with a sewer extension built in accordance with chapter 436 of the Acts of 1897 by the Metropolitan Sewerage Commission as an outlet for part of the town of Stoneham and made parts of the North Metropolitan Sewerage System.

[3] Includes 2.631 miles of sewer purchased from the town of Arlington.

[4] Mostly buildings connected with a sewer formerly belonging to the town of Arlington but later purchased by the Metropolitan Sewerage Commission in accordance with chapter 520 of the Acts of 1897 and made a part of the North Metropolitan Sewerage System.

[5] The Metropolitan Sewer extends but a few feet into the town of Belmont.

[6] Includes 2.787 miles of Mystic valley sewer in Medford and Winchester, running parallel with the metropolitan sewer.

South Metropolitan Sewerage System.

Location, Length and Sizes of Sewers, with Public and Special Connections.

City or Town.	Size of Sewers.	Length in Miles.	Public Connections, December 31, 1921.	Special Connections. Character or Location of Connection.	Special Connections. Number in Operation.
Boston: —					
Back Bay	6′ 6″ to 3′ 9″	1.500[1]	16	Tufts Medical School	1
				Private house	1
				Administration Building, Boston Park Department	1
				Simmons College Buildings	1
				Art Museum	2
Brighton	5′ 9″×6′ 0″ to 12″	6.010[2]	15	Abattoir	3
				Chocolate works	2
				Machine shop	1
Dorchester	3′×4′ to 2′ 6″×2′ 7″	2.870[3]	13	Paper Mill	1
				Private buildings	3
				Edison Electric Company Station	1
				Mattapan Paper Mills	1
Hyde Park	10′ 7″×11′ 7″ to 4′ 0″×4′ 1″	4.527	18	Private buildings	2
				Fairview Cemetery Buildings	1
Roxbury	6′ 6″×7′ to 4′ 0″	1.430	–	– –	–
				Caledonia Grove buildings	1
West Roxbury	9′ 3″×10′ 2″ to 12″	7.643	17	Parental School	1
				Lutheran Evangelical Church	1
				Private buildings	4
Brookline	6′ 6″×7′ 0″ to 8″	2.540[4]	12	Private buildings	2
Dedham	4′×4′ 1″ to 2′ 9″×3′	5.012	7	Dedham Carpet Mills	1
Hull[5]	60″ pipe	0.750	–	– –	–
Milton	11′×12′ to 8″	3.600	23	Private buildings	2
Newton	4′ 2″×4′ 9″ to 1′ 3″	2.911	8	Private houses	7
				Metropolitan Water Works blow-off	1
Quincy	11′ 3″×12′ 6″ to 24″ pipe	6.845	15	Squantum schoolhouse	1
Waltham	3′ 6″×4′ 0″	0.001	1	– –	–
				Factories	2
Watertown	4′ 2″×4′ 9″ to 12″	0.750[6]	6	Stanley Motor Carriage Co.	1
				Knights of Pythias building	1
Needham[5]	2′ 0″×2′ 3″ to 2′ 3″×2′ 6″	4.921	–	– –	–
Wellesley[7]	– –	–	1	– –	–
		51.310	152		46

[1] Includes .355 of a mile of sewer purchased from the city of Boston.

[2] Includes .446 of a mile of pipe and concrete sewers built for the use of the city of Boston; also .026 of a mile of sewer purchased from the town of Watertown.

[3] Includes 1.24 miles of sewer purchased from the city of Boston.

[4] Includes .158 of a mile of pipe sewer built for the use of the town of Brookline.

[5] Hull and Needham are not parts of the Metropolitan Sewerage District.

[6] Includes .025 of a mile of sewer purchased from the town of Watertown.

[7] The metropolitan sewer extends but a few feet into the town of Wellesley.

Information relating to areas, populations, local sewer connections and other data for the metropolitan sewerage districts appears in the following table: —

North Metropolitan Sewerage District.

Area (Square Miles).	Estimated Total Population.	Miles of Local Sewer connected.	Estimated Population contributing Sewage.	Ratio of Contributing Population to Total Population (Per Cent.).	Connections made with Metropolitan Sewers.	
					Public.	Special.
100.32	643,030	800.21	588,430	91.5	321	574

South Metropolitan Sewerage District.

110.76	488,960	703.00	374,960	76.7	152	46

Both Metropolitan Sewerage Districts.

211.08	1,131,990	1,503.21	963,390	85.1	473	620

Of the estimated gross population of 1,131,990 on December 31, 1921, 963,390 representing 85.1 per cent, were on that date contributing sewage to the metropolitan sewers, through a total length of 1,503.21 miles of local sewers owned by the individual cities and towns of the districts.

These sewers are connected with the metropolitan systems by 473 public and 620 special connections. During the current year there has been an increase of 43.07 miles of local sewers connected with the metropolitan systems, and 5 public and 9 special connections have been added.

CONSTRUCTION.

NORTH METROPOLITAN SEWERAGE SYSTEM.

Reading Pumping Station.

The construction of a reservoir and pump well for this station was described in previous reports.

A pumping station building has been erected in Reading at the junction of Summer Avenue and Elm Street. This consists of a brick building 26 by 32 feet and basement, having a slate roof and concrete floors. This building was practically completed on October 15, 1921.

In this building are located two pumping units. This machinery, which was furnished by the Starkweather & Broadhurst Company of Boston, consists of one 2,500,000-gallon capacity centrifugal

pump and one 4,000,000-gallon capacity centrifugal pump operating against a head of 65 feet and actuated by electric motors of 75 horsepower and 100 horsepower, respectively. The pumps were built by the Morris Machine Works, and have 8-inch and 10-inch discharge pipes, respectively. They are located in a pit which is 44 feet below the level of the floor of the station, and are driven by vertical shafts which directly connect the motors with the pumps. The motors were manufactured by the General Electric Company, and are of the slip ring type. They are operated at speeds of 1,200 and 900 r. p. m., respectively, with a 60-cycle, 3-phase current of 440 volts. At present the current is supplied by the municipal plant of the town of Reading. Provisions have been made in the station for the installation of an engine of the semi-Diesel type, with a direct connected generator which will generate current on the premises.

Because of delay in the appropriation, and further delay on the part of the contractors in furnishing the machinery, the pumping units were not installed ready for use until December 7, 1921.

The construction of the pumping station building and the installation of the pumping machinery, including electrical equipments, were all done by the regular maintenance employees of the Metropolitan Sewerage Division.

SOUTH METROPOLITAN SEWERAGE SYSTEM.

Wellesley Extension.

The only uncompleted work on this extension at the beginning of the year was a portion of Sections 100 and 101. These sections are fully described in last year's report. Work was completed and the sewer was opened for the use of the town of Wellesley on July 17, 1921.

MAINTENANCE.

SCOPE OF WORK AND FORCE EMPLOYED.

The maintenance of the Metropolitan Sewerage System includes the operation of eight pumping stations, the Nut Island screenhouse and 118.113 miles of metropolitan sewers, receiving the discharge from 1,503.21 miles of town and city sewers at 473 points, together with the care and study of inverted siphons under streams and in the harbor.

Owing to the addition of about 11 miles of metropolitan sewers and an additional pumping station, it has been necessary to increase the permanent maintenance force. At present this consists of 172 men, of whom 107 are employed on the North System and 65 on the South System. These are subdivided as follows: North Metropolitan System, 64 engineers and other employees in the pumping stations, and 43 men, including foremen, on maintenance, care of sewer lines, buildings and grounds; South Metropolitan System, 36 engineers and other employees in the pumping stations, and 29 men, including foremen, on maintenance, care of sewer lines, buildings and grounds.

The regular work of this Department, in addition to the operation of the pumping stations, has consisted of routine work of cleaning and inspecting sewers and siphons, caring for tide gates, regulators and overflows, measuring flow in sewers, inspection of connections to the metropolitan sewers, and the care of pumping stations and other buildings and grounds.

In addition to these regular duties other work has been done by the maintenance employees of this Department, as follows: —

Deer Island Pumping Station.

Repairs were made on the 12-inch salt-water injection pipe which furnishes water for the condensers. It was necessary to renew part of this pipe and to install a brass strainer.

Repairs to pump No. 3 in this station, consisting of the placing of a new composition sleeve on the 10-inch shaft, rebabbitting and otherwise repairing the bearing near the pump case, were completed.

A new 3-inch brass pipe for boiler feed use about 100 feet in length was installed.

East Boston Pumping Station.

A basement extending from the westerly end of the pumping station building to the third engine pit was constructed. This enables the inspection and repairing of pipes and conduits which were inaccessible.

The south chimney at this station became so badly cracked as to require its partial rebuilding. The defect occurred at a point about 18 feet below the top. A staging which was carried to the top of

the chimney was erected by the maintenance force to make an examination. A contract was entered into with Emil Malmstrom & Son Company for taking down and rebuilding the upper portion of the chimney. Work was finished on the repairs, which included repointing the entire chimney, on May 16, 1921.

The cylinders of the condenser pump for engine No. 3 were replaced by new ones which were constructed in the machine shop at this station.

Repairs were made to pump No. 3 at this station during the year. These consisted of a new sleeve on the 10-inch shaft, and repairs to one of the impellers of the pump which had been broken off about 6 inches from the outer end. The bearing of this pump was also rebabbitted.

Charlestown Pumping Station.

Two new sewage screens have been constructed and installed at this station.

The pumps, engines and pits at this station were repainted.

The 42-inch gate valve in the suction conduit leading to pump No. 1 became inoperative. This has been repaired.

Quincy Pumping Station.

New cylinder linings were put in the 5,000,000-gallon Deane pump. A new throttle valve and connecting steam piping were also furnished for this pumping engine.

During the flood period of the year it was necessary to open the relief valve and discharge sewage on the salt-water marshes adjacent to this station. The pumping plant, although in good condition, was not able to handle the large sewage flow.

Recommendation to the Legislature was made by the Metropolitan Water and Sewerage Board in 1919 that an appropriation should be made for the installation of additional pumping machinery at this station. The Legislature, however, did not see fit to grant the appropriation.

Nut Island Screen-house.

At this station considerable mechanical work for the north and south districts has been accomplished in addition to the regular work of operating the screen-house and the Hough's Neck pumping station. These consist chiefly of the making of over 3,600 pounds

of brass castings for various repair work in the pumping stations, and the overhauling and repairing and painting of the White automobile truck used in the south district, together with the complete overhauling of the machinery on board the naphtha towboat used in the harbor work.

A severe storm of last year so badly damaged the eastern slopes of Nut Island that it was necessary to build an additional sea wall. This new wall connects the existing wall near the wharf with the slope paving crossing the bar.

Sewerage District Map.

A new lithograph map of the Metropolitan Sewerage Districts, bringing the same up to July 1, 1921, has been published during the year. This was printed by the Walker Lithograph and Publishing Company.

Old Mystic Valley Sewer.

That part of the old Mystic valley sewer which was constructed by the city of Boston in 1878 to protect the Mystic water supply extending between Cross Street and Prospect Street in Woburn was sold to the city of Woburn for a nominal sum. This sewer, which was owned by the Metropolitan Water Works and operated as a local sewer for the city of Woburn and maintained by the Metropolitan Sewerage Works, has been of considerable trouble and expense to the District. Its ownership and care were transferred to the city of Woburn December 22, 1921.

Gasolene in Public Sewers.

The efforts to improve the condition of the metropolitan sewers in regard to dangers resulting from the introduction of gasolene into the same have been continued throughout the year and have been successful.

An inspector has been employed in this Department whose duty it is to visit existing garages and see that the separators are kept in proper condition, also to enforce the regulation concerning the installation of such separators at all newly constructed garages.

At the request of the Metropolitan District Commission the Department of Public Safety has made an effort to assist in the protection of the metropolitan sewers from gasolene. A set of

regulations concerning garages and their appurtenances has been published by them, and they have recognized the fact that by statute they are charged with the supervision and control of the effluent from these establishments which is discharged into the sewers.

During the year 94 new garages and other establishments using gasolene have been connected with the local sewer systems which discharge into the metropolitan sewers.

The following tables show the particulars in regard to establishments known to be using gasolene, and which are connected with the public sewerage systems of the different municipalities in the Metropolitan Sewerage Districts: —

NORTH METROPOLITAN SEWERAGE DISTRICT.

Table showing Number of Places where Gasolene is used which are connected with Public Sewers, December 31, 1921.

CITY OR TOWN.	Total Number of Places connected with Sewer.	Number of New Garages built and connected with Sewers, 1921.
Arlington	7	1
Belmont	4	–
Boston:		
Charlestown District	29	3
East Boston District	34	5
Cambridge	166	22
Chelsea	31	2
Everett	25	1
Lexington	3	1
Malden	29	3
Medford	19	3
Melrose	9	2
Revere	13	–
Somerville	113	13
Stoneham	7	1
Wakefield	6	–
Winchester	14	–
Winthrop	4	–
Woburn	4	–
Reading	–	–
Totals	517	57

SOUTH METROPOLITAN SEWERAGE DISTRICT.

Table showing Number of Places where Gasolene is used which are connected with Public Sewers, December 31, 1921.

CITY OR TOWN.	Total Number of Places connected with Sewer.	Number of New Garages built and connected with Sewers, 1921.
Boston:		
Hyde Park District	21	6
West Roxbury District	38	2
Back Bay District	60	–
Brighton District	80	5
Jamaica Plain District	5	1
Dorchester District	50	3
Brookline	108	12
Dedham	3	–
Milton	1	–
Newton	55	3
Quincy	23	2
Waltham	13	1
Watertown	19	2
Wellesley	–	–
Totals	476	37

DRAINAGE FROM TANNERIES, GELATINE AND GLUE WORKS IN WINCHESTER, WOBURN AND STONEHAM.

Four men and a foreman have been employed during a part of the year flushing and cleaning the metropolitan sewers through the tannery districts in Winchester, Woburn and Stoneham.

All the tanneries and glue works of the District now have settling tanks of substantial size. This method of treatment has very greatly reduced the amount of sludge material entering the metropolitan sewers.

The following table gives details of settling tanks introduced to date, showing the operations of same with the amount of sludge collected and removed: —

Table of Semi-fluid Sludge removed from Settling Basins at the Tanneries, Gelatine and Glue Works in Winchester, Woburn and Stoneham, Year ending December 31, 1921.

Location of Basin.	Basin put in Operation.	Inside Measurement of Basin (Feet).	Number of Times cleaned during Year.	Average Quantity Semi-fluid Sludge removed during Year (Cubic Yards).	Total Quantity Semi-fluid Sludge removed during Year (Cubic Yards).
Beggs & Cobb Company, rotary screen process.[1]	Dec. 12, 1917	–	–	–	296.00
Beggs & Cobb Company, wooden settling basin.	Aug. 12, 1919	6.0× 4.0	51	–	776.00
Beggs & Cobb Company, outlet intercepting sump.	July 16, 1919	12.0× 8.0	3	11.00	33.00
American Hide and Leather Company, Factory D.[2, 3]	Nov. 15, 1910	48.0×23.1	–	–	–
Dorington Leather Company[4]	Dec. 10, 1910	47.2×23.0	8	106.84	854.72
E. Cummings Leather Company[3]	Nov. 1, 1910	45.9×22.6	3	97.60	292.80
W. P. Fox & Sons[3]	July 12, 1910	47.8×22.6	13	270.40	3,515.20
Thayer & Foss[3]	Sept. 15, 1910	48.1×23.1	15	209.80	3,147.00
Van Tassell Leather Company[2]	May 1, 1911	10.2×14.5	–	–	–
Van Tassell Leather Company[4]	May 1, 1911	43.8×19.5	2	102.00	204.00
Van Tassell Leather Company[4]	Dec. 26, 1919	6.0× 4.0	–	–	–
American Glue Company[4]	Oct. 1, 1910	47.1×23.0	8	136.36	1,090.88
J. O. Whitten Company[4]	1902	35.5×24.7	34	58.74	1,997.16
J. O. Whitten Company[4]	1902	67.2×12.0	17	8.50	144.50
Morris Kaplan[2]	Jan. 9, 1911	46.8×22.9	–	–	–
Morris Kaplan	Jan. 9, 1911	4.0× 4.0	52	1.00	52.00
Morris Kaplan	Mar. 5, 1921	6.5× 6.0	21	7.00	147.00
Morris Kaplan	Mar. 5, 1921	6.0× 5.0	21	5.50	115.50
Atlantic Gelatine Company	Mar. 12, 1920	30-ft. diameter.	2	100.00	200.00
Total	–	–	–	–	12,865.76

[1] Daily, continuous.
[2] Not used in 1921.
[3] To be maintained by city of Woburn in 1922.
[4] Used part time in 1921.

North Metropolitan Sewerage System.

Table showing Cities and Towns delivering Sewage to this System; Approximate Miles of Sewers connected; Estimated Populations and Areas now contributing; Total Areas ultimately to contribute, and Present Populations on Such Areas; Ratios of Present Contributing Areas to Ultimate Areas, and Ratios of Populations now contributing to Present Total Populations.

[Populations estimated as of December 31, 1921.]

Cities and Towns.	Miles of Local Sewers connected.	Separate or Combined.	Number of Connections with Local Sewers.	Estimated Number of Persons served by Each House Connection.[1]	Estimated Population now contributing Sewage.	Estimated Present Total Population.	Estimated Area now contributing Sewage.	Area ultimately to contribute Sewage.	Ratio of Contributing Population to Present Total Population.	Ratio of Contributing Area to Ultimate Area.
							Sq. Miles.	Sq. Miles.	Per Cent.	Per Cent.
Boston (Deer Island)	0.70	Separate	–	–	220[2]	220	–	–	100.00	–
Winthrop	32.55	Separate	3,114	5.20	16,190	16,380	1.40	1.61	98.80	87.0
Boston (East Boston)	34.02	Separate and combined	5,160	11.95	61,660	62,120	1.17	2.18	99.30	53.7
Chelsea	31.72	Separate and combined	4,345	10.05	43,670	44,580	1.17	2.24	98.00	52.2
Everett	48.67	Separate and combined	5,228	7.10	37,120	41,760	2.04	3.34	88.90	61.1
Malden	67.95	Separate	7,411	6.40	47,430	50,850	3.17	5.07	93.30	62.5
Melrose	39.92	Separate	3,479	4.60	16,000	18,690	1.91	3.73	85.60	51.2
Boston (Charlestown)	21.73	Separate and combined	5,472	6.35	34,750	34,910	0.67	1.27	99.50	52.8
Cambridge	157.72	Separate and combined	17,021	6.50	110,640	111,580	5.05	6.11	99.20	82.7
Somerville	101.79	Separate and combined	16,160	5.90	95,340	96,200	3.51	3.96	99.10	88.6
Medford	67.43	Separate	6,534	6.30	41,160	41,970	3.26	8.35	98.10	39.0
Winchester	33.64	Separate	2,103	5.10	10,720	10,770	1.66	5.95	99.50	27.9
Woburn	16.69[3]	Separate	1,328	5.60	7,440	16,830	1.04	12.71	44.20	8.2
Stoneham	13.60	Separate	1,016	4.80	4,880	8,020	0.72	5.50	60.80	13.1
Arlington	34.41	Separate	2,674	6.00	16,040	19,420	2.07	5.20	82.60	39.8
Belmont	22.98	Separate	1,516	6.70	10,680[4]	11,650	1.38	4.66	91.70	29.6
Wakefield	14.93	Separate	905	5.30	4,800	13,440	0.63	7.65	35.70	8.2
Lexington	6.99	Separate	143	4.60	660	5,020	0.26	5.11	13.10	5.1
Revere	44.87	Separate	3,941	7.10	27,980	30,950	2.19	5.86	90.40	37.4
Reading	7.90	Separate	263	4.00	1,050	7,670	0.37	9.82	13.70	3.8
Totals	800.21	– –	87,813	6.70	588,430	643,030	33.67	100.32	91.50	33.6

[1] Estimated from assessors' statement of the number of houses in each city or town on April 1, 1921, and the population from census of 1920.

[2] Estimated by Supt. Geo. M. Harlow of the institution on Deer Island.

[3] Exclusive of Mystic valley sewer and tanneries.

[4] Including 2 connections with McLean Hospital, having an estimated population of 523.

South Metropolitan Sewerage System.

Table showing Cities and Towns delivering Sewage to this System; Approximate Miles of Sewers connected; Estimated Populations and Areas now contributing; Total Areas ultimately to contribute, and Present Populations on Such Areas; Ratios of Present Contributing Areas to Ultimate Areas, and Ratios of Populations now contributing to Present Total Populations.

[Populations estimated as of December 31, 1921.]

Cities and Towns.	Miles of Local Sewers connected.	Separate or Combined.	Number of Connections with Local Sewers.	Estimated Number of Persons served by Each House Connection.[1]	Estimated Population now contributing Sewage.	Estimated Present Total Population.	Estimated Area now contributing Sewage.	Area ultimately to contribute Sewage.	Ratio of Contributing Population to Present Total Population.	Ratio of Contributing Area to Ultimate Area.
							Sq. Miles.	Sq. Miles.	Per Cent.	Per Cent.
Boston (Back Bay)	26.68	Separate and combined	1,920	17.20	33,020	33,170	1.15	1.61	99.5	71.4
Boston (Brighton)	65.42	Separate and combined	4,177	10.20	42,610	42,900	3.27	3.74	99.3	87.4
Brookline	75.53	Separate and combined	5,202	7.50	39,020	39,230	3.66	6.81	99.5	53.7
Newton	135.43	Separate	8,226	5.50	45,240	47,150	8.15	16.88	95.9	48.3
Watertown	48.65	Separate	3,169	6.85	21,710	21,930	2.35	4.04	99.0	58.2
Waltham	48.25	Separate	4,029	7.65	30,820	31,720	2.48	13.63	97.2	18.2
Boston (Dorchester)	60.10	Separate and combined	6,102	9.20	56,140[2]	84,930[2]	2.66	4.89	66.1[2]	54.4
Milton	18.79	Separate and combined	1,197	4.80	5,750	9,630	1.02	12.59	59.7	8.1
Boston (Hyde Park)	35.87	Separate	2,536	7.40	18,770	19,310	1.69	4.57	97.2	37.0
Dedham	17.61	Separate	947	5.60	5,300	11,100[3]	0.88	9.40	47.7	9.4
Boston (Roxbury)[4]	–	–	–	–	–	48,120[2]	–	1.23	–	–
Boston (West Roxbury)	62.19	Separate and combined	4,228	6.80	31,010[2, 5]	43,070[2]	2.82	8.92	72.0[2]	31.6
Quincy	91.24	Separate	7,230	6.00	43,380	50,100	3.75	12.56	86.6	29.9
Wellesley	17.24	Separate	533	4.10	2,190	6,600	0.85	9.89	33.2	8.6
Totals	703.00	–	49,496	7.60	374,960	488,960	34.73	110.76	76.7	31.4

[1] Estimated from assessors' statement of the number of houses in each city or town on April 1, 1921, and the population from census of 1920.

[2] Parts of Dorchester, Milton, Roxbury and West Roxbury which are situated within the South Metropolitan Sewerage System limits are tributary at present to Boston main drainage works.

[3] Part of town not included in Metropolitan Sewerage District.

[4] At present connected with Boston main drainage system.

[5] Including connection with institutions at Austin Farm, having an estimated population of 2,257.

Both Metropolitan Sewerage Systems.

Table showing Areas delivering Sewage to both Systems; Approximate Miles of Sewers connected, Estimated Populations and Areas now contributing; Total Areas ultimately to contribute, and Present Populations on Such Areas; Ratios of Present Contributing Areas to Ultimate Areas, and Ratios of Populations now contributing to Present Total Populations.

[Populations estimated as of December 31, 1921.]

System.	Miles of Local Sewers connected.	Separate or Combined.	Number of Connections with Local Sewers.	Estimated Number of Persons served by Each House Connection.	Estimated Population now contributing Sewage.	Estimated Present Total Population.	Estimated Area now contributing Sewage.	Area ultimately to contribute Sewage.	Ratio of Contributing Population to Present Total Population.	Ratio of Contributing Area to Ultimate Area.
							Sq. Miles.	Sq. Miles.	Per Cent.	Per Cent.
North Metropolitan .	800.21	Separate and combined	87,813	6.7	588,430	643,030	33.67	100.32	91.5	33.6
South Metropolitan .	703.00	Separate and combined	49,496	7.6	374,960	488,960	34.73	110.76	76.7	31.4
Totals . . .	1,503.21	– –	137,309	7.0	963,390	1,131,990	68.40	211.08	85.1	32.4

PUMPING STATIONS.

Capacities and Results.

The following table shows the comparison of the growth in the amount of sewage handled and the total cost of the operation of the different stations in 1921 with the same items of 1920 and of 1914 when prices had not been affected by the war: —

Pumping Station.	Sewage pumped in 1921 increased over that of —		Cost of Operation in 1921 increased over that of —	
	1920.	1914.	1920.	1914.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Deer Island	7[1]	17	3[1]	113
East Boston	7[1]	17	9[1]	83
Charlestown	6[1]	19	8[1]	62
Alewife Brook	11[1]	31	8[1]	49
Quincy	2[1]	45	27[1]	64
Ward Street	3[1]	25	22[1]	65

[1] Decrease.

Average Daily Volume of Sewage lifted at Each of the Six Principal Metropolitan Sewerage Pumping Stations and at the Quincy (Hough's Neck) Sewage Lifting Station during the Year, as compared with the Corresponding Volumes for the Previous Year.

Pumping Station.	Average Daily Pumpage.			
	Jan. 1, 1921, to Dec. 31, 1921.	Jan. 1, 1920, to Dec. 31, 1920.	Decrease during the Year.	
	Gallons.	Gallons.	Gallons.	Per Cent.
Deer Island	68,600,000	74,000,000	5,400,000	7.3
East Boston	66,600,000	72,000,000	5,400,000	7.5
Charlestown	38,900,000	41,400,000	2,500,000	6.0
Alewife Brook	4,591,000	5,156,000	565,000	11.0
Quincy	5,776,000	5,918,000	142,000	2.4
Ward Street (actual gallons pumped)	33,333,000	34,261,000	928,000	2.7
Quincy (Hough's Neck) sewage lifting station.	224,300	225,600	1,300	.6

North Metropolitan System.

Deer Island Pumping Station.

At this station are four submerged centrifugal pumps with impeller wheels 8.25 feet in diameter, driven by triple-expansion engines of the Reynolds-Corliss type.

Contract capacity of 1 pump: 100,000,000 gallons, with 19-foot lift.
Contract capacity of 3 pumps: 45,000,000 gallons each, with 19-foot lift.
Average duty for the year: 53,200,000 foot pounds.
Average quantity raised each day: 68,600,000 gallons.
Force employed: 4 engineers, 1 relief engineer, 4 firemen, 4 oilers, 3 screenmen, 1 relief screenman and 1 laborer.
Coal used: bituminous, costing from $9.28 to $16.75 per gross ton.

Table of Approximate Quantities, Lifts and Duties at the Deer Island Pumping Station of the North Metropolitan System.

Months.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (Foot Pounds per 100 Pounds Coal).
1921.						
January	2,169,700,000	70,000,000	50,100,000	92,500,000	11.33	49,900,000
February	1,802,700,000	64,400,000	51,100,000	120,800,000	11.48	54,700,000
March	2,390,800,000	77,100,000	50,400,000	117,900,000	11.16	53,200,000
April	2,000,900,000	66,700,000	53,200,000	92,200,000	11.65	54,200,000
May	2,335,400,000	75,300,000	48,300,000	125,100,000	12.00	49,500,000
June	1,724,500,000	57,500,000	50,100,000	115,500,000	11.08	53,600,000
July	3,030,900,000	97,800,000	65,100,000	151,200,000	11.86	57,000,000
August	2,117,700,000	68,300,000	54,200,000	91,700,000	10.84	57,700,000
September	1,604,500,000	53,500,000	44,000,000	63,200,000	11.22	57,200,000
October	1,630,100,000	52,600,000	41,900,000	67,900,000	10.94	43,900,000
November	1,979,900,000	66,000,000	42,600,000	134,700,000	11.67	50,200,000
December	2,290,800,000	73,900,000	56,200,000	115,900,000	11.35	56,800,000
Total	25,077,900,000	–	–	–	–	–
Average	–	68,600,000	50,600,000	107,400,000	11.38	53,200,000

Average Cost per Million Foot Gallons for Pumping at the Deer Island Station.

Volume (25,077.9 Million Gallons) × Lift (11.38 Feet) = 285,386.5 Million Foot Gallons.

Items.	Cost.	Cost per Million Foot Gallons.
Labor	$28,564 28	$0.10009
Coal	32,099 32	.11248
Oil	418 04	.00146
Waste	121 03	.00042
Water	1,457 54	.00511
Packing	232 75	.00081
Miscellaneous supplies and renewals	1,719 78	.00603
Totals	$64,612 74	$0.22640
Labor at screens	$5,400 40	–

East Boston Pumping Station.

At this station are four submerged centrifugal pumps, with impeller wheels 8.25 feet in diameter, driven by triple-expansion engines of the Reynolds-Corliss type.

Contract capacity of 1 pump: 100,000,000 gallons with 19-foot lift.
Contract capacity of 3 pumps: 45,000,000 gallons each, with 19-foot lift.
Average duty for the year: 66,900,000 foot pounds.
Average quantity raised each day: 66,600,000 gallons.
Force employed: 4 engineers, 2 relief engineers, 3 firemen, 1 relief fireman, 4 oilers, 3 screenmen, 1 relief screenman, 3 helpers and 1 laborer.
Coal used: bituminous costing from $9.04 to $13.50 per gross ton.

Table of Approximate Quantities, Lifts and Duties at the East Boston Pumping Station of the North Metropolitan System.

Months.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (Foot Pounds per 100 Pounds Coal).
1921.						
January	2,107,700,000	68,000,000	48,100,000	90,500,000	13.93	67,100,000
February	1,746,700,000	62,400,000	49,100,000	118,800,000	13.89	70,800,000
March	2,328,800,000	75,100,000	48,400,000	115,900,000	13.85	65,000,000
April	1,940,900,000	64,700,000	51,200,000	90,200,000	14.31	67,000,000
May	2,273,400,000	73,300,000	46,300,000	123,100,000	14.25	65,000,000
June	1,664,500,000	55,500,000	48,100,000	113,500,000	14.07	76,000,000
July	2,968,900,000	95,800,000	63,100,000	149,200,000	14.53	73,500,000
August	2,055,700,000	66,300,000	52,200,000	89,700,000	13.59	70,600,000
September	1,544,500,000	51,500,000	42,000,000	61,200,000	12.53	47,500,000 [1]
October	1,568,100,000	50,600,000	39,900,000	65,900,000	13.22	54,200,000 [1]
November	1,919,900,000	64,000,000	40,600,000	132,700,000	13.88	60,000,000
December	2,228,800,000	71,900,000	54,200,000	113,900,000	14.31	85,800,000
Total	24,347,900,000	–	–	–	–	–
Average	–	66,600,000	48,600,000	105,400,000	13.86	66,900,000

[1] During these months 75 per cent of the pumping was done by the old pumps No. 1 and No. 2. Extensive repairs were being made on pump No. 3.

Average Cost per Million Foot Gallons for Pumping at the East Boston Station.

Volume (24,347.9 Million Gallons) × Lift (13.86 Feet) = 337,461.9 Million Foot Gallons.

Items.	Cost.	Cost per Million Foot Gallons.
Labor	$34,842 03	$0.10325
Coal	29,793 65	.08829
Oil	1,011 95	.00300
Waste	101 19	.00030
Water	1,773 42	.00525
Packing	166 24	.00049
Miscellaneous supplies and renewals	3,601 16	.01067
Totals	$71,289 64	$0.21125
Labor at screens	$2,220 42	–

Charlestown Pumping Station.

At this station are three submerged centrifugal pumps, two of them having impeller wheels 7.5 feet in diameter, the other 8.25 feet in diameter. They are driven by triple-expansion engines of the Reynolds-Corliss type.

Contract capacity of 1 pump: 60,000,000 gallons with 8-foot lift.
Contract capacity of 2 pumps: 22,000,000 gallons each, with 11-foot lift.
Average duty for the year: 46,300,000 foot pounds.
Average quantity raised each day: 38,900,000 gallons.
Force employed: 4 engineers, 1 relief engineer, 4 firemen, 3 oilers, 3 screenmen and 1 relief screenman.
Coal used: bituminous, costing from $9.11 to $17.50 per gross ton.

Table of Approximate Quantities, Lifts and Duties at the Charlestown Pumping Station of the North Metropolitan System.

Months.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (Foot Pounds per 100 Pounds Coal).
1921.						
January	1,169,600,000	37,700,000	24,900,000	51,500,000	7.38	44,200,000
February	1,024,100,000	36,600,000	29,900,000	67,800,000	6.93	38,000,000
March	1,336,800,000	43,100,000	31,900,000	62,600,000	8.36	51,400,000
April	1,097,300,000	36,600,000	26,200,000	57,200,000	7.45	42,800,000
May	1,395,000,000	45,000,000	28,500,000	66,900,000	8.14	53,000,000
June	1,146,800,000	38,200,000	30,800,000	77,500,000	7.56	46,000,000
July	1,741,300,000	56,200,000	33,700,000	88,500,000	8.49	62,000,000
August	1,151,500,000	37,100,000	25,900,000	56,400,000	7.56	43,700,000
September	1,010,500,000	33,700,000	23,900,000	49,700,000	7.02	36,300,000
October	903,900,000	29,200,000	23,100,000	42,000,000	7.28	38,000,000
November	1,094,200,000	36,500,000	20,800,000	67,500,000	7.59	44,500,000
December	1,141,900,000	36,800,000	23,900,000	62,800,000	8.11	55,100,000
Total	14,212,900,000	–	–	–	–	–
Average	–	38,900,000	27,000,000	62,500,000	7.66	46,300,000

Average Cost per Million Foot Gallons for Pumping at the Charlestown Station

Volume (14,212.9 Million Gallons) × Lift (7.66 Feet) = 108,870.8 Million Foot Gallons.

Items.	Cost.	Cost per Million Foot Gallons.
Labor	$21,294 92	$0.19560
Coal	10,495 92	.09641
Oil	479 39	.00440
Waste	39 55	.00036
Water	997 92	.00917
Packing	76 99	.00071
Miscellaneous supplies and renewals	804 75	.00739
Totals	$34,189 44	$0.31404
Labor at screens	$4,019 24	–

Alewife Brook Pumping Station.

The plant at this station consists of two 9-inch Andrews commercial centrifugal pumps, direct connected by horizontal shafts to compound marine engines, together with a pump and engine added later. The latter consists of a specially designed engine of the vertical cross-compound type, having between the cylinders a centrifugal pump rotating on a horizontal axis.

Contract capacity of the 2 original pumps: 4,500,000 gallons each, with 13-foot lift.
Contract capacity of new pump: 13,000,000 gallons, with 13-foot lift.
Average duty for the year: 19,000,000 foot pounds.
Average quantity raised each day: 4,591,000 gallons.
Force employed: 3 engineers, 1 relief engineer, 3 screenmen and 1 relief screenman.
Coal used: bituminous, costing from $9.20 to $13.48 per gross ton.

Table of Approximate Quantities, Lifts and Duties at the Alewife Brook Pumping Station of the North Metropolitan System.

Months.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (Foot Pounds per 100 Pounds Coal).
1921.						
January	150,170,000	4,844,000	3,910,000	6,754,000	13.05	17,200,000
February	120,846,000	4,316,000	3,718,000	8,170,000	13.00	16,300,000
March	196,548,000	6,340,000	4,922,000	8,111,000	13.04	22,500,000
April	150,844,000	5,028,000	4,318,000	6,813,000	13.02	19,200,000
May	187,715,000	6,055,000	4,026,000	10,223,000	12.99	21,600,000
June	99,117,000	3,304,000	2,739,000	6,577,000	12.95	18,100,000
July	230,038,000	7,421,000	4,201,000	13,264,000	13.13	25,300,000
August	126,868,000	4,093,000	2,881,000	6,636,000	12.97	20,300,000
September	84,313,000	2,810,000	2,456,000	4,085,000	12.92	16,600,000
October	82,256,000	2,653,000	2,372,000	3,574,000	12.90	15,300,000
November	105,020,000	3,501,000	2,330,000	6,813,000	12.87	16,600,000
December	146,470,000	4,725,000	3,814,000	7,049,000	12.31	18,800,000
Total	1,680,205,000	–	–	–	–	–
Average	–	4,591,000	3,474,000	7,339,000	12.93	19,000,000

Average Cost per Million Foot Gallons for Pumping at the Alewife Brook Station.

Volume (1,680.205 Million Gallons) × Lift (12.93 Feet) = 21,725.05 Million Foot Gallons.

Items.	Cost.	Cost per Million Foot Gallons.
Labor	$8,148 39	$0.37507
Coal	4,906 01	.22582
Oil	371 84	.01712
Waste	117 81	.00542
Water	257 64	.01186
Packing	26 10	.00120
Miscellaneous supplies and renewals	266 81	.01228
Totals	$14,094 60	$0.64877
Labor at screens, oiling and miscellaneous services	$4,705 80	–

Reading Pumping Station.

At this station are two submerged centrifugal pumps of 2,500,000 gallons per 24 hours, and 4,000,000 gallons per 24 hours, capacity. These operate against a maximum head of 65 feet, and are actuated by vertical shafts directly connected with 75 and 100 horsepower motors. Alternating current of 440 volts furnished by the municipal plant of the town of Reading is used.

Plant opened for use . . . . . December 7, 1921
Average gallons pumped per 24 hours 750,000

Force employed, 1 engineer-mechanic, 1 assistant and 1 watchman.

At present the effluent is nearly all ground water leakage into the local sewers. Effort is being made by the town to reduce this.

South Metropolitan System.

Ward Street Pumping Station.

At this station are two vertical, triple-expansion pumping engines, of the Allis-Chalmers type, operating reciprocating pumps, the plungers of which are 48 inches in diameter with a 60-inch stroke.

Contract capacity of 2 pumps: 50,000,000 gallons each, with 45-foot lift.
Average duty for the year: 83,899,000 foot pounds.
Average quantity raised each day: 33,333,000 gallons.
Force employed: 4 engineers, 1 relief engineer, 4 firemen, 5 oilers, 4 assistant engineers, 1 machinist and 1 laborer.
Coal used: bituminous, costing from $9.49 to $10.90 per gross ton.
Material intercepted at screens during the year: 1,697.8 cubic yards.

Table of Approximate Quantities, Lifts and Duties at the Ward Street Pumping Station of the South Metropolitan System.

Months.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (Foot Pounds per 100 Pounds Coal).
1921.						
January	1,092,150,000	35,230,000	29,840,000	46,186,000	40.72	73,129,000
February	821,961,000	29,350,000	28,024,000	50,853,000	40.18	64,719,000
March	1,218,398,000	39,270,000	34,000,000	50,324,000	41.17	77,000,000
April	1,038,028,000	34,601,000	31,051,000	41,673,000	41.18	84,800,000
May	1,265,712,000	40,827,000	31,772,000	56,231,000	41.10	90,700,000
June	921,481,000	30,716,000	25,773,000	55,666,000	41.59	87,564,000
July	1,355,520,000	43,726,000	33,651,000	65,686,000	41.53	109,000,000
August	1,025,698,000	33,087,000	26,253,000	39,249,000	40.85	96,326,000
September	785,651,000	26,188,000	23,510,000	33,832,000	42.13	84,776,000
October	786,562,000	25,372,000	22,855,000	29,848,000	42.39	77,884,000
November	866,002,000	28,866,000	22,686,000	49,200,000	42.30	76,497,000
December	1,015,582,000	32,761,000	28,980,000	50,777,000	41.72	84,387,000
Total	12,192,745,000	–	–	–	–	–
Average	–	33,333,000	28,200,000	47,460,000	41.41	83,899,000

Records from plunger displacements.

Average Cost per Million Foot Gallons for Pumping at the Ward Street Station.

Volume (12,192.745 Million Gallons) × Lift (41.41 Feet) = 504,901.6 Million Foot Gallons.

Items.	Cost.	Cost per Million Foot Gallons.
Labor	$27,441 86	$0.05435
Coal	22,293 70	.04415
Oil	402 78	.00080
Waste	27 95	.00006
Water	1,647 36	.00326
Packing	419 71	.00083
Miscellaneous supplies and renewals	1,673 01	.00331
Totals	$53,906 37	$0.10676
Labor at screens	$6,660 75	–

Quincy Pumping Station.

At this station are two compound condensing Deane pumping engines and one Lawrence centrifugal pump driven by a Sturtevant compound condensing engine.

Contract capacity of 3 pumps: Deane, 3,000,000 gallons; Deane, 5,000,000 gallons; Lawrence centrifugal, 10,000,000 gallons.
Average duty for the year: 31,900,000 foot pounds.
Average quantity raised each day: 5,776,000 gallons.
Force employed: 3 engineers, 1 relief engineer, 3 screenmen and 1 relief screenman.
Coal used: bituminous, costing from $10.59 to $10.72 per gross ton.
Material intercepted at screen during the year: 364 cubic yards.

Table of Approximate Quantities, Lifts and Duties at the Quincy Pumping Station of the South Metropolitan System.

Months.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (Foot Pounds per 100 Pounds Coal).
1921.						
January	172,415,000	5,562,000	4,590,000	7,477,000	27.80	27,600,000
February	129,132,000	4,612,000	4,226,000	6,112,000	25.48	25,400,000
March	204,310,000	6,591,000	5,276,000	12,352,000	32.67	32,200,000
April	165,050,000	5,502,000	4,904,000	6,247,000	28.62	31,900,000
May	281,075,000	9,067,000	5,015,000	12,961,000	28.83	38,800,000
June	134,815,000	4,494,000	3,613,000	7,925,000	23.19	31,300,000
July	315,418,000	10,175,000	6,412,000	17,835,000	29.81	43,300,000
August	176,011,000	5,678,000	4,363,000	11,704,000	25.64	33,300,000
September	125,795,000	4,193,000	3,685,000	5,400,000	21.99	30,400,000
October	109,263,000	3,525,000	3,150,000	3,946,000	20.96	28,100,000
November	123,906,000	4,130,000	3,136,000	11,366,000	22.04	28,400,000
December	179,272,000	5,783,000	4,817,000	10,838,000	25.84	31,700,000
Total	2,116,462,000	–	–	–	–	–
Average	–	5,776,000	4,432,000	9,514,000	26.07	31,900,000

Average Cost per Million Foot Gallons for Pumping at the Quincy Station.

Volume (2,116.462 Million Gallons) × Lift (26.07 Feet) = 55,176.16 Million Foot Gallons.

Items.	Cost.	Cost per Million Foot Gallons.
Labor	$7,644 45	$0.13855
Coal	6,455 97	.11700
Oil	190 53	.00345
Waste	51 10	.00093
Water	344 02	.00623
Packing	57 95	.00105
Miscellaneous supplies and renewals	746 25	.01353
Totals	$15,490 27	$0.28074
Labor at screens, oiling and miscellaneous services	$5,283 75	–

Nut Island Screen-house.

The plant at this house includes two sets of screens in duplicate actuated by small reversing engines of the Fitchburg type. Two vertical Dean boilers, 80 horse power each, operate the engines, provide heat and light for the house, burn materials intercepted at the screens, and furnish power for the Quincy (Hough's Neck) sewage lifting station.

Average daily quantity of sewage passing screens: 67,000,000 gallons.
Total material intercepted at screens: 1,118.4 cubic yards.
Material intercepted per million gallons of sewage discharged: 1.23 cubic feet.
Force employed: 3 engineers, 1 relief engineer, 3 screen men and 1 relief screen man.
Coal used: bituminous, costing $9.09 per gross ton.

Quincy (Hough's Neck) Sewage Lifting Station.

At this station are two 6-inch submerged Lawrence centrifugal pumps with vertical shafts actuated by two Sturtevant direct-current motors.

The labor and electric energy for this station are supplied from the Nut Island screen-house, and as used at present it does not materially increase the amount of coal used at the latter station. The effluent is largely ground water.

Contract capacity of 2 pumps: about 1,500,000 gallons each, with 20-foot lift.
Average daily amount pumped: 224,300 gallons.
Average lift: 15.19 feet.

Coal delivered in the Bins of the Sewerage Pumping Stations during the Year.

	Gross Tons, Bituminous Coal.							
	Deer Island Pumping Station.	East Boston Pumping Station.	Charlestown Pumping Station.	Alewife Brook Pumping Station.	Ward Street Pumping Station.	Quincy Pumping Station.	Nut Island Screenhouse.	Price Per Gross Ton.[1]
Maritime Coaling Company	585	–	–	–	–	–	–	$9 28
Maritime Coaling Company	421	–	–	–	–	–	–	9 41
Maritime Coaling Company	1,025	–	–	–	–	–	–	9 48
Maritime Coaling Company	470	–	–	–	–	–	–	9 69
Maritime Coaling Company	510	–	–	–	–	–	–	9 73
Maritime Coaling Company	–	535	–	–	–	–	–	9 04
Maritime Coaling Company	–	265	–	–	–	–	–	9 11
Maritime Coaling Company	–	511	–	–	–	–	–	9 24
Maritime Coaling Company	–	995	–	–	–	–	–	9 32
New England Coal and Coke Company.	–	700	–	–	–	–	–	9 50
City Fuel Company	–	500	–	–	–	–	–	12 50
City Fuel Company	–	22	–	–	–	–	–	12 60
Maritime Coaling Company	–	–	575	–	–	–	–	9 11
Maritime Coaling Company	–	–	168	–	–	–	–	9 12
Maritime Coaling Company	–	–	300	–	–	–	–	9 19
City Fuel Company	–	–	45	–	–	–	–	10 90
City Fuel Company	–	–	300	–	–	–	–	12 50
New England Fuel and Supply Company.	–	–	–	96	–	–	–	9 21
Metropolitan Coal Company	–	–	–	29	–	–	–	10 39
Metropolitan Coal Company	–	–	–	240	–	–	–	10 57
Metropolitan Coal Company	–	–	–	17	–	–	–	10 62
Anderson Coal Sales Company	–	–	–	–	408	–	–	9 49
Anderson Coal Sales Company	–	–	–	–	184	–	–	9 94
Metropolitan Coal Company	–	–	–	–	480	–	–	10 36
Metropolitan Coal Company	–	–	–	–	522	–	–	10 46
Metropolitan Coal Company	–	–	–	–	208	–	–	10 51
Metropolitan Coal Company	–	–	–	–	236	–	–	10 57
Metropolitan Coal Company	–	–	–	–	86	–	–	10 90

[1] Includes adjustments for quality.

Coal delivered in the Bins of the Sewerage Pumping Stations during the Year — Concluded.

	Gross Tons, Bituminous Coal.							Price per Gross Ton.[1]
	Deer Island Pumping Station.	East Boston Pumping Station.	Charlestown Pumping Station.	Alewife Brook Pumping Station.	Ward Street Pumping Station.	Quincy Pumping Station.	Nut Island Screenhouse.	
City Fuel Company . . .	–	–	–	–	–	107	–	$10 59
City Fuel Company . . .	–	–	–	–	–	119	–	10 67
City Fuel Company . . .	–	–	–	–	–	377	–	10 72
Maritime Coaling Company . .	–	–	–	–	–	–	400	9 09
Total bituminous . . .	3,011	3,528	1,388	382	2,124	603	400	–
Average cost	$9 50	$9 79	$9 92	$10 22	$10 23	$10 69	$9 09	–

[1] Includes adjustments for quality.

Metropolitan Sewerage Outfalls.

The Metropolitan Sewerage Districts now have outfalls in Boston Harbor at five points, two of which may discharge sewage from the North District and three from the South District. These outfalls are all in good condition.

During the year the sewage of the North District has been discharged wholly through the outlet located near Deer Island light. The other outfall of this system is closed by a cast-iron cover which can be easily removed.

Of the outfalls of the South District, two extend for a distance exceeding one mile from the shore of Nut Island, Quincy, and the third one, called an emergency outlet, extends about 1,500 feet from the same. During the flood periods of May and July, 1921, all three of these outfalls were in operation. No discharge is made through the emergency outlet excepting at such flood periods.

During the year the average flow through the North Metropolitan District outfall at Deer Island has been 68,600,000 gallons of sewage per 24 hours, with a maximum rate of 151,200,000 gallons during an exceptionally stormy period in July, 1921. The amount of sewage discharged in the North Metropolitan District averaged 117 gallons per day for each person, taking the estimated population of

the District contributing sewage. If the sewers in this District were restricted to the admission of sewage proper only, this per capita amount would be considerably decreased.

In the South Metropolitan District an average of 67,000,000 gallons of sewage has passed daily through the screens at the Nut Island Screen-house, and has been discharged from the outfalls into the outer harbor. The maximum rate of discharge per day which occurred during an exceptionally stormy period in May, 1921, was 178,000,000 gallons. The discharge of sewage through these outfalls represents the amount of sewage contributed by the South Metropolitan District, which was at the rate of 179 gallons per day per person of the estimated number contributing sewage in the District.

The daily discharge of sewage per capita is considerably larger in the South Metropolitan District than it is in the North Metropolitan District, because, owing to the large size and unused capacity of the south district high-level sewer, more storm water is at present admitted to the sewers of this District.

Material Intercepted at the Screens.

The material intercepted at the screens at the North Metropolitan sewerage stations, consisting of rags, paper and other floating materials, has during the year amounted to 1,346.6 cubic yards. This is equivalent to 1.45 cubic feet for each million gallons of sewage pumped at Deer Island.

The material intercepted at the screens at the South Metropolitan sewerage stations has amounted to 3,180.2 cubic yards, equal to 3.51 cubic feet per million gallons of sewage delivered at the outfall works at Nut Island.

Studies of sewage flows in the metropolitan sewers and siphons indicate that they are free from deposit.

FREDERICK D. SMITH,
Director and Chief Engineer of Sewerage Division.

Boston, January 2, 1922.

FINANCIAL STATEMENT.

PARKS DIVISION.

Loan Appropriations.

The appropriations heretofore made in the form of loans, with accretions thereto, are as follows: —

Metropolitan Parks Loan Fund.

Original appropriation, chapter 407, Acts of 1893	$1,000,000 00
General appropriation, chapter 483, Acts of 1894	500,000 00
Charles River Act, chapter 509, Acts of 1894	300,000 00
General appropriation, chapter 305, Acts of 1895	500,000 00
General appropriation, chapter 466, Acts of 1896	1,000,000 00
General appropriation, chapter 464, Acts of 1897	500,000 00
General appropriation, chapter 530, Acts of 1898	1,000,000 00
Revere Beach Bath-house Act, chapter 142, Acts of 1899	125,000 00
General appropriation, chapter 406, Acts of 1899	300,000 00
Charles River Improvement Act, chapter 465, Acts of 1900	50,000 00
Fuller's Wharf Act, chapter 467, Acts of 1900	30,000 00
General appropriation, chapter 445, Acts of 1901	450,000 00
Mystic River Bridge Act, chapter 492, Acts of 1901	200,000 00
General appropriation, chapter 290, Acts of 1903	125,000 00
Newton Upper Falls Bridge Act, chapter 391, Acts of 1903	40,000 00
Continuing appropriation, chapter 429, Acts of 1903	1,500,000 00
Nahant Beach Bath-house Act, chapter 326, Acts of 1904	70,000 00
Reimbursing loan for moth expense, chapter 486, Acts of 1906	50,000 00
Purification of Mystic River, Alewife Brook and adjacent water-courses, ponds and drainage areas, chapter 529, Acts of 1906,	100,000 00
Additional appropriation for purification of Mystic River, etc., chapter 529, Acts of 1907	25,000 00
Mystic River and Winthrop Shore Act, chapter 652, Acts of 1908	70,000 00
Charles River Land Act, chapter 628, Acts of 1910, and chapter 439, Acts of 1911	143,043 96
Alewife Brook Purification Act, chapter 458, Acts of 1911	15,000 00
Work for unemployed, chapter 4, General Acts of 1915	50,000 00
Weston Bridge Act, chapter 368, Special Acts of 1915	50,000 00
	$8,193,043 96

To provide for interest and sinking fund requirements to 1900, chapter 311, Acts of 1897	$900,000 00
Total amount of loans	$9,093,043 96
Amounts received from sales of buildings, receipts from bath-houses, fines, etc.	198,942 81
Total	$9,291,986 77

METROPOLITAN PARKS LOAN FUND, SERIES II.

Original boulevard, chapter 288, Acts of 1894	$500,000 00
General appropriation, chapter 472, Acts of 1896	500,000 00
General appropriation, chapter 521, Acts of 1897	1,000,000 00
Saugus Bridge Act, Chapter 547, Acts of 1898	100,000 00
General appropriation, chapter 428, Acts of 1899	500,000 00
Mattapan Bridge Act, chapter 443, Acts of 1900	75,000 00
Winchester Act, chapter 444, Acts of 1900	50,000 00
Revere Beach Parkway Act, chapter 445, Acts of 1900	200,000 00
General appropriation, chapter 172, Acts of 1902	450,000 00
General appropriation, chapter 359, Acts of 1903	110,000 00
Continuing appropriation, chapter 419, Acts of 1903	1,500,000 00
Alewife Brook and Fresh Pond Parkway Act, chapter 651, Acts of 1908	50,000 00
Continuing appropriation, chapter 699, Acts of 1912	1,000,000 00
Wellington Bridge Act, chapter 794, Acts of 1914	115,000 00
Work for unemployed, chapter 5, Special Acts of 1915	50,000 00
Alewife Brook Parkway construction, chapter 243, General Acts of 1915	35,000 00
Neponset Bridge Act, chapter 300, General Acts of 1915	350,000 00
Wellington Bridge Act, chapter 178, General Acts of 1916	11,000 00
Improvement of lands in Arlington, chapter 186, General Acts of 1916	20,000 00
Parkway connecting Blue Hills Reservation and Granite Street, Braintree, chapter 235, General Acts of 1916	10,000 00
Construction of Dedham Parkway, chapter 237, General Acts of 1916	10,000 00
Additional appropriation for Neponset Bridge construction, chapter 220, General Acts of 1917	100,000 00
Settlement of claims for land, Furnace Brook Parkway, chapter 316, General Acts of 1917	8,000 00
Completion of boulevards and roadways, chapter 175, General Acts of 1919	250,000 00
Additional appropriation for Neponset Bridge construction, chapter 238, General Acts of 1919	170,000
	$7,164,000 00

To provide for interest and sinking fund requirements to 1900, chapter 311, Acts of 1917	$100,000 00
Total amount of loans	$7,264,000 00
Receipts from sales, etc.	36,123 82
Total	$7,300,123 82

NANTASKET BEACH LOAN.

Appropriation, chapter 464, Acts of 1899	$600,000 00
Appropriation, chapter 456, Acts of 1901	100,000 00
Total amount of loans	$700,000 00
Receipts from rents, etc.	5,881 50
Total	$705,881 50

CHARLES RIVER BASIN LOAN.

Bonds issued for 1904	$250,000 00
Bonds issued for 1905	400,000 00
Bonds issued for 1906	600,000 00
Bonds issued for 1907	1,150,000 00
Bonds issued for 1908	400,000 00
Bonds issued for 1909	850,000 00
Bonds issued for 1910	475,000 00
Bonds issued for 1911	300,000 00
Appropriation, chapter 539, Acts of 1913	40,000 00
Driveway, Brooks Street to Charlesbank Road, chapter 188, General Acts of 1915	35,000 00
Total amount of bonds	$4,500,000 00
Receipts added to loan	9,368 91
Total	$4,509,368 91

CHARLES RIVER BRIDGES LOAN.

Western Avenue–Arsenal Street bridge, chapter 497, Acts of 1921	$175,000 00
Western Avenue bridge, chapter 497, Acts of 1921	275,000 00
River Street–Brighton Street bridge, chapter 497, Acts of 1921	275,000 00
Brookline Street–Essex Street–Cottage Farm bridge, chapter 497, Acts of 1921	750,000 00
	$1,475,000 00

EXPENDITURES FROM LOANS.

The following tables show the total amount expended in each of the foregoing loans, the total cost of each reservation and park-

way to Dec. 1, 1921, and the amount charged by the Auditor's department to meet the sinking fund and interest requirements previous to Jan. 1, 1900. The item of "Miscellaneous" in these tables includes cost of construction of roads, buildings and of all other work of construction, and all other charges against these loans except those for land, general expenses, sinking fund and cost of maintenance required by law to be charged to loans up to 1897. The total charges for maintenance to 1897, general expenses and sinking fund are given separately at the end of the tables. The amounts expended from these loans for the fiscal year ending Nov. 30, 1921, are stated in tables on pages 111 and 112. The total amounts charged to those loans are as follows: —

METROPOLITAN PARKS LOAN FUND.

Land	$5,395,148 66
Miscellaneous, including construction of roads, buildings, etc.	3,395,496 79
General expense	163,371 12
Maintenance to Jan. 1, 1897, sinking fund assessments to Jan. 1, 1900, and interest	290,326 56
Transfer to Serial Bond Loan	3,601 10
	$9,247,944 23

METROPOLITAN PARKS LOAN FUND, SERIES II.

Land	$2,296,936 49
Miscellaneous, including construction of roads, buildings, etc.	4,199,230 10
General expense	107,090 19
Sinking fund assessments to Jan. 1, 1900, and one-half interest	59,195 89
	$6,662,452 67

NANTASKET BEACH LOAN.

Land	$603,329 57
Miscellaneous, including construction of buildings, etc.	102,551 93
	$705,881 50

EXPENDITURES TO DEC. 1, 1921.

METROPOLITAN PARKS LOAN FUND.

Blue Hills Reservation: —		
Land	$363,357 29	
Miscellaneous	307,058 66	
		$670,415 95

Middlesex Fells Reservation: —		
Land	$691,162 69	
Miscellaneous	294,557 47	
		$985,720 16
Revere Beach Reservation: —		
Land	$1,162,947 67	
Miscellaneous	800,999 04	
		1,963,946 71
Stony Brook Reservation: —		
Land	$281,243 87	
Miscellaneous	76,810 67	
		358,054 54
Beaver Brook Reservation: —		
Land	$29,819 29	
Miscellaneous	24,437 35	
		54,256 64
Hemlock Gorge Reservation: —		
Land	$53,254 00	
Miscellaneous	15,543 94	
		68,797 94
Charles River Reservation: —		
Land	$1,569,391 51	
Miscellaneous	341,121 43	
		1,910,512 94
Neponset River Reservation: —		
Land	$233,473 04	
Miscellaneous	46,418 97	
		279,892 01
Mystic River Reservation: —		
Land	$245,233 21	
Miscellaneous	380,830 51	
		626,063 72
Lynn Shore Reservation: —		
Land	$361,199 29	
Miscellaneous	243,580 01	
		604,779 30
Quincy Shore Reservation: —		
Land	$73,726 26	
Miscellaneous	198,160 63	
		271,886 89
Winthrop Shore Reservation: —		
Land	$51,067 32	
Miscellaneous	170,560 99	
		221,628 31

Hart's Hill Reservation: —		
Land	$10,000 00	
Miscellaneous	202 35	
		$10,202 35
King's Beach Reservation: —		
Land	$24,297 21	
Miscellaneous	1,551 63	
		25,848 84
West Roxbury Parkway: —		
Land	$244,976 01	
Miscellaneous	8,313 67	
		253,289 68
Wellington Bridge: —		
Miscellaneous	$185,317 42	
		185,317 42
Nahant Beach Bath-house: —		
Miscellaneous	$67,794 58	
		67,794 58
Boylston Street Bridge: —		
Miscellaneous	$45,838 57	
		45,838 57
Alewife Brook Purification: —		
Miscellaneous	$136,398 90	
		136,398 90
Weston Bridge: —		
Miscellaneous	$50,000 00	
		50,000 00
General expense		163,371 12
		$8,954,016 57
Sinking fund requirements to 1896	$18,980 18	
Care and maintenance to July 1, 1896	85,813 46	
Care and maintenance, July 1, 1896, to Jan. 1, 1897	19,604 06	
Sinking fund assessment for 1897	63,630 70	
Sinking fund assessment for 1898	9,755 55	
Sinking fund assessment for 1899	64,224 00	
Interest	28,318 61	
Transfer to Serial Bond Loan (unexpended balance Alewife Brook purification appropriation)	3,601 10	
		293,927 66
Total charged to Dec. 1, 1921		$9,247,944 23
Balance Dec. 1, 1921		44,042 54
		$9,291,986 77

METROPOLITAN PARKS LOAN FUND, SERIES II.

Blue Hills Parkway: —		
Land	$133,505 02	
Miscellaneous	269,513 47	
		$403,018 49
Middlesex Fells Parkway: —		
Land	$263,687 60	
Miscellaneous	613,667 39	
		877,354 99
Mystic Valley Parkway: —		
Land	$203,990 91	
Miscellaneous	426,421 06	
		630,411 97
Revere Beach Parkway: —		
Land	$537,445 51	
Miscellaneous	869,565 65	
		1,407,011 16
Neponset River Parkway: —		
Land	$83,941 75	
Miscellaneous	36,100 54	
		120,042 29
Fresh Pond Parkway: —		
Land	$44,086 25	
Miscellaneous	31,635 58	
		75,721 83
Furnace Brook Parkway: —		
Land	$173,897 77	
Miscellaneous	272,064 36	
		445,962 13
Nahant Beach Parkway: —		
Land	$80,940 78	
Miscellaneous	76,260 11	
		157,200 89
Lynn Fells Parkway: —		
Land	$40,468 46	
Miscellaneous	126,373 84	
		166,842 30
Winthrop Parkway: —		
Land	$134,090 73	
Miscellaneous	90,011 11	
		224,101 84
Alewife Brook Parkway: —		
Land	$144,497 74	
Miscellaneous	45,705 13	
		190,202 87

Charles River Speedway: —		
Miscellaneous	$521,348 66	
		$521,348 66
Blue Hills roads: —		
Miscellaneous	$8,742 06	
		8,742 06
Middlesex Fells roads: —		
Miscellaneous	$79,444 42	79,444 42
Stony Brook roads: —		
Miscellaneous	$37,183 45	
		37,183 45
Lynnway: —		
Land	$20,500 00	
Miscellaneous	124,368 29	
		144,868 29
Spy Pond Parkway: —		
Miscellaneous	$89 04	
		89 04
Old Colony Parkway: —		
Land	$307,321 36	
Miscellaneous	84,530 36	
		391,851 72
Woburn Parkway: —		
Land	$4,608 75	
Miscellaneous	52,038 32	
		56,647 07
Dedham Parkway: —		
Land	$22,027 01	
Miscellaneous	34,322 88	
		56,349 89
Hammond Pond Parkway: —		
Land	$94,965 85	
Miscellaneous	5,061 45	
		100,027 30
Quannapowitt Parkway: —		
Land	$6,961 00	
Miscellaneous	1,831 82	
		8,792 82
West Roxbury Parkway: —		
Miscellaneous	$57,420 97	
		57,420 97

Vose's Grove: —		
Miscellaneous	$980 08	
		$980 08
Wellington Bridge: —		
Miscellaneous	$120,796 40	
		120,796 40
Neponset Bridge: —		
Miscellaneous	$167,057 26	
		167,057 26
Arlington Parkway: —		
Miscellaneous	$4,035 12	
		4,035 12
Nonantum Road: —		
Miscellaneous	$41,271 43	
		41,271 43
West Street, Braintree: —		
Miscellaneous	$1,389 85	
		1,389 85
General expense		107,090 19
		$6,603,256 78
Sinking fund requirements for 1896	$3,650 03	
Sinking fund requirements for 1897	14,057 10	
Sinking fund requirements for 1898	3,765 08	
Sinking fund requirements for 1899	15,396 00	
One-half interest	22,327 68	
		59,195 89
Total charged to Dec. 1, 1921		$6,662,452 67
Balance Dec. 1, 1921		637,671 15
		$7,300,123 82

NANTASKET BEACH LOAN.

Land	$603,329 57	
Miscellaneous	102,551 93	
Total charged to Dec. 1, 1921		$705,881 50

Charles River Basin Loan.

Expended from beginning of work to Dec. 1, 1921		$4,472,802 22

The above amount has been distributed as follows: —

Administration	$108,165 16	
Dam	1,118,772 60	
Lock	724,142 64	
Temporary bridge and approaches	184,895 36	
Drawbridge	100,371 06	
Highway	55,557 85	
Dredging, pile-driving and protection work in Basin	179,881 35	
Broad Canal	117,251 64	
Lechmere Canal	53,388 87	
Boston Embankment	895,213 92	
Boston Marginal Conduit	635,511 96	
Cambridge Marginal Conduit	99,472 48	
Elimination of malarial mosquitoes	1,173 68	
Landing piers	7,667 99	
Float anchorage	23 90	
Police signal system	9,847 56	
Improvement of south bank and driveway	31,506 09	
Service sheds	19,198 95	
Mortuary	1,560 66	
Otter Street widening	34,762 82	
Landing near Faneuil Station	1,057 83	
Alterations and improvements in stable and stable yard	2,052 15	
Shelters	2,615 19	
Rent of land	2 00	
Maintenance	88,708 51	
		$4,472,802 22

Charles River Bridges Loan.

Cottage Farm bridge:		
Miscellaneous	$625 68	
Balance Dec. 1, 1921	1,474,374 32	
		$1,475,000 00

Metropolitan Parks Trust Fund.

Receipts	$40,379 89	
Expenditures	38,106 50	
Balance Dec. 1, 1921		$2,273 39

Detailed Statement.

Expenditures Dec. 1, 1920, to Dec. 1, 1921.

Metropolitan Parks Loan Fund.

Metropolitan Parks Loan Fund		$9,093,043 96
Receipts added to loan before June 1, 1901		198,942 81
		$9,291,986 77

Expenditures.

Charles River Reservation:				
Claims		$200 00		
Mystic River Reservation:				
Land	$1,500 00			
Legal	15 00			
		1,515 00		
			$1,715 00	
Amounts charged to Dec. 1, 1920			9,246,229 23	
				9,247,944 23
Balance				$44,042 54

Metropolitan Parks Loan Fund, Series II.

Metropolitan Parks Loan Fund, Series II		$7,264,000 00
Receipts from sales, etc.		36,123 82
		$7,300,123 82

Expenditures.

Mystic Valley Parkway:				
Dredging Aberjona River			$998 50	
Furnace Brook Parkway:				
Iron fence		$246 24		
Frames and grates		33 18		
Advertising		24 30		
			303 72	
Winthrop Parkway:				
Land			700 00	
Middlesex Fells Roads:				
Engineering:				
Expenses			12 75	
Old Colony Parkway:				
Land		$7,500 00		
Filling material		1,443 45		
Engineering:				
Services	$717 83			
Expenses	2 80			
		720 63		
Claims		100 00		
			9,764 08	
Woburn Parkway:				
Land			650 00	
Amounts carried forward			$12,429 05	$7,300,123 82

Amounts brought forward		$12,429 05	$7,300,123 82
Dedham Parkway:			
Construction:			
Contract, Powers Bros.	$3,286 00		
Advertising	66 15		
Engineering:			
Expenses	2 49		
		3,354 64	
Quannapowitt Parkway:			
Land		336 00	
West Roxbury Parkway:			
Construction:			
Contract, Rowe Contracting Company	$7,200 64		
Labor and materials	580 00		
	$7,780 64		
Engineering:			
Expenses	40		
		7,781 04	
Neponset Bridge:			
Engineering:			
Services	$2,322 89		
Expenses	5 64		
	$2,328 53		
Rental of land	500 00		
Printing contracts	302 48		
Consulting engineers	272 50		
Advertising	185 55		
		3,589 06	
Nonantum Road:			
Construction:			
Contract, Alexander Palladino	$1,200 54		
Labor and materials	135 08		
	$1,335 62		
Engineering:			
Services	$503 48		
Expenses	3 60		
	507 08		
Advertising	133 65		
		1,976 35	
		$29,466 14	
Amounts charged to Dec. 1, 1920		6,632,986 53	
			6,662,452 67
Balance			$637,671 15

North Beacon Street Bridge Loan.

Chapter 780, Acts of 1914	$175,000 00
Amounts charged to Dec. 1, 1920	174,853 50
Balance	$146 50

Charles River Basin Loan.

Total amount of loan			$4,500,000 00
Receipts added to loan			9,368 91
Total			$4,509,368 91
Amounts charged to Dec. 1, 1920		$4,472,747 22	
		55 00	
			4,472,802 22
Balance			$36,566 69

Charles River Bridges Loan.

Appropriation (chapter 497, Acts of 1921)	$1,475,000 00

Expenditures.

Cottage Farm Bridge:			
Construction:			
Labor and material		$393 20	
Engineering:			
Services	$232 08		
Expenses	40		
	232 48		
		625 68	
Balance			$1,474,374 32

Metropolitan Parks System Maintenance.

Appropriation Dec. 1, 1920, to Dec. 1, 1921	$718,700 00

Expenditures.

General expense:				
Police:				
Pay rolls	$172,020 52			
Miscellaneous	17,150 71			
		$189,171 23		
Salaries:				
Commissioners	$2,500 00			
General office	10,452 69			
Engineering department	12,580 11			
		25,532 80		
Rent, lighting and care of offices		4,678 33		
Stationery and printing		1,314 02		
Office supplies		749 94		
Telephones		722 45		
Engineering:				
Office supplies	$501 79			
Automobile expense	184 86			
		686 65		
Maps and books		234 68		
Traveling		1 00		
			$223,091 10	
Blue Hills Reservation: —				
General labor		$53,955 10		
Gypsy and brown-tail moth work:				
Labor	$36,147 77			
Supplies	6,873 31			
		43,021 08		
Road repairs:				
Labor	$1,615 35			
Supplies	1,922 91			
		3,538 26		
Horses, carriages, automobiles, etc.		6,577 61		
General supplies		3,486 24		
Keep of horses		3,169 50		
Telephones		346 61		
Stationery and printing		292 71		
Water rates		210 81		
Repairs		178 33		
Amounts carried forward		$114,776 25	$223,091 10	$718,700 00

Amounts brought forward		$114,776 25	$223,091 10	$718,700 00
Lighting buildings		174 26		
Physicians' services		96 00		
Postage		35 22		
Express and freight		20 95		
			115,102 68	
Middlesex Fells Reservation:				
General labor		$34,147 63		
Gypsy and brown-tail moth work:				
Labor	$26,771 36			
Supplies	1,827 93			
		28,599 29		
Road repairs:				
Labor	$11,308 80			
Supplies	823 10			
		12,131 90		
Garage		11,172 84		
General supplies		3,263 66		
Keep of horses		2,841 85		
Horses, carriages, automobiles, etc.		975 34		
Lighting buildings		501 38		
Rent		450 00		
Stationery and printing		412 58		
Repairs		381 81		
Telephones		379 75		
Water rates		52 89		
Express and freight		43 27		
Physicians' services		43 00		
Postage		28 75		
Traveling		3 94		
			95,429 88	
Revere Beach Reservation:				
General labor		$39,354 92		
Road repairs:				
Labor	$650 00			
Supplies	105 47			
		755 47		
General supplies		6,019 99		
Street lighting		4,868 60		
Horses, carriages, automobiles, etc.		1,857 90		
Repairs		1,146 22		
Keep of horses		1,087 24		
Lighting buildings		684 30		
Telephones		453 40		
Stationery and printing		336 68		
Water rates		160 72		
Postage		28 00		
Express		24 29		
			56,777 73	
Stony Brook Reservation:				
General labor		$3,781 46		
Gypsy and brown-tail moth work:				
Labor	$4,499 95			
Supplies	2,073 28			
		6,573 23		
Road repairs:				
Labor		546 40		
Keep of horses		77 25		
Telephones		44 75		
Water rates		17 60		
General supplies		9 85		
			11,050 54	
Amounts carried forward			$501,451 93	$718,700 00

Amounts brought forward			$501,451 93	$718,700 00
Beaver Brook Reservation:				
General labor		$1,693 59		
Gypsy and brown-tail moth work:				
Labor		560 85		
General supplies		334 77		
Repairs		126 66		
Water rates		63 95		
Telephones		52 70		
Keep of horses		19 90		
Lighting buildings		10 40		
Auto expense		1 70		
Express and freight		65		
			2,865 17	
Charles River Upper Division:				
General labor		$33,260 76		
Gypsy and brown-tail moth work:				
Labor	$11,755 71			
Supplies	1,140 34			
		12,896 05		
Road repairs:				
Labor	$2,247 38			
Supplies	5,803 80			
		8,051 18		
General supplies		9,600 27		
Horses, carriages, automobiles, etc.		4,207 01		
Keep of horses		1,677 06		
Street lighting		1,596 73		
Water rates		472 36		
Lighting buildings		442 70		
Telephones		440 37		
Stationery and printing		426 76		
Repairs		330 21		
Legal services		75 00		
Express and freight		30 09		
Physicians' services		27 00		
Postage		27 00		
Traveling		23 05		
Advertising		6 00		
Rent of land		1 00		
			73,590 60	
Riverside Recreation Grounds:				
General labor		$4,128 32		
General supplies		1,130 83		
Repairs		395 45		
Lighting buildings		224 37		
Telephones		107 75		
Horses, carriages, automobiles, etc.		105 34		
Rental of sewer		85 00		
Water rates		58 70		
Electric power		31 95		
Stationery and printing		12 96		
Express and freight		10 35		
Postage		2 00		
			6,293 02	
Neponset River Reservation:				
General labor		$100 00		
Gypsy and brown-tail moth work:				
Labor	$593 15			
Supplies	900 00			
		1,493 15		
Telephones		46 92		
			1,640 07	
Amounts carried forward			$585,840 79	$718,700 00

Amounts brought forward			$585,840 79	$718,700 00
Mystic River Reservation:				
General labor		$16,460 39		
General supplies		1,404 34		
Repairs		284 31		
Electric power		250 00		
Street lighting		79 21		
Horses, carriages, automobiles, etc.		59 18		
Telephones		57 12		
Stationery and printing		6 53		
Water rates		6 45		
Keep of horses		6 34		
Postage		4 00		
Traveling		1 00		
Express		58		
			18,619 45	
Lynn Shore Reservation:				
General labor		$11,111 42		
Road repairs:				
Labor	$517 65			
Supplies	853 83			
		1,371 48		
General supplies		2,716 20		
Street lighting		2,520 00		
Repairs		147 72		
Automobile expense		68 83		
Water rates		17 55		
			17,953 20	
Quincy Shore Reservation:				
General labor		$11,596 86		
Gypsy and brown-tail moth work:				
Supplies		364 00		
Road repairs:				
Supplies		232 00		
Street lighting		1,841 86		
General supplies		529 26		
Telephones		58 00		
Water rates		44 15		
Lighting buildings		36 91		
Repairs		22 85		
			14,725 89	
Winthrop Shore Reservation:				
General labor		$3,592 06		
Road repairs:				
Labor	$928 10			
Supplies	997 35			
		1,925 45		
General supplies		1,128 89		
Street lighting		615 96		
Auto expense		49 50		
Water rates		22 63		
Repairs		13 90		
			7,348 39	
Pensions:				
Woodbury O. Chamberlin		$926 57		
Michael F. Cadegan		899 98		
Timothy Donahue		899 98		
James A. Philbrick		899 98		
James C. White		899 98		
Robert Elder		842 37		
Patrick E. Barry		734 16		
Amounts carried forward		$6,103 02	$644,487 72	$718,700 00

Amounts brought forwa d	$6,103 02	$644,487 72	$718,700 00
George D. Armstrong	667 43		
William Kenney	667 43		
Royal L. Lord	667 43		
Salem P. Haddock	638 75		
Isabel M. Ellis	600 00		
Annie L. Finn	600 00		
Myrtle Harding	600 00		
Mary E. Stewart	600 00		
Catherine F. McCarthy	598 07		
Benjamin Finn	593 11		
Annie T. Powers	400 00		
Ruth Woodworth	350 00		
Ella P. Mateer	300 00		
		13,385 24	
			657,872 96
Balance			$60,827 04

Special Appropriations.

Band Concerts.

Appropriation			$20,000 00

Expenditures.

Blue Hills Division: —			
Bands		$778 00	
Middlesex Fells Division:			
Bands		3,686 20	
Revere Beach Division:			
Bands		2,660 00	
Charles River Upper Division:			
Bands	$2,946 00		
Extra police	4 00		
		2,950 00	
Nahant Beach Parkway:			
Bands		1,527 50	
Nantasket Beach Reservation:			
Bands		7,379 71	
Bunker Hill Monument:			
Bands		192 50	
General expense:			
Advertising		16 95	
			19,190 86
Balance			$809 14

Dredging Aberjona River.

Appropriation (chapter 629, item 635, Acts of 1920)	$5,000 00
Amounts charged to Dec. 1, 1921	4,918 26
Balance	$81 74

Charles River Upper Division.

Appropriation (chapter 203, item 630c, Acts of 1921)		$20,000 00
Expenditure.		
Architects' services		500 00
Balance		$19,500 00

Widening Cradock Bridge.

Appropriation (chapter 398, Acts of 1921)			$20,000 00
Expenditures.			
Construction:			
Contract, Simpson Brothers	$7,225 00		
Labor and material	56 54		
		$7,281 54	
Engineering:			
Services	$1,297 92		
Expenses	4 60		
		1,302 52	
Advertising		30 00	
			8,614 06
Balance			$11,385 94

Cambridge Parkway Maintenance.

Appropriation			$54,700 00
Expenditures.			
General labor		$12,311 92	
Road repairs:			
Labor	$6,685 18		
Supplies	10,498 99		
		17,184 17	
Police:			
Pay rolls	$6,455 90		
Miscellaneous	80 59		
		6,536 49	
Repair fence		3,440 02	
Street lighting		3,358 96	
General supplies		2,400 70	
Engineering:			
Services	$1,629 36		
Expenses	34 33		
		1,663 69	
Automobile expense		1,584 73	
Water rates		114 72	
Repairs		109 86	
Telephones		98 17	
Stationery and printing		6 17	
			48,809 60
Balance			$5,890 40

Metropolitan Parks, Boulevard Maintenance.

Appropriation Dec. 1, 1920, to Dec. 1, 1921 . . . . . $440,900 00

Expenditures.

General expense:			
Police:			
Pay rolls	$69,793 53		
Miscellaneous	14,101 55		
		$83,895 08	
Salaries:			
Commissioners	$2,500 00		
General office	10,653 64		
Engineering department	11,041 95		
		24,195 59	
Rent, lighting and care of offices		4,467 04	
Engineering:			
Office supplies	$1,346 79		
Automobile expense	497 04		
		1,843 83	
Office supplies		1,618 34	
Stationery and printing		1,188 96	
Maps and books		402 25	
Telephones		364 19	
Traveling		40	
			$117,975 68
Blue Hills Parkway:			
General labor		$16,752 60	
Gypsy and brown-tail moth work:			
Labor		981 11	
Road repairs:			
Supplies		1,417 19	
Street lighting		2,995 68	
General supplies		2,800 69	
Advertising		246 90	
Horses, carriages, automobiles, etc.		160 16	
Repairs		29 10	
Water rates		22 31	
Lighting buildings		9 00	
			25,414 74
Middlesex Fells Parkway:			
General labor		$20,250 49	
Gypsy and brown-tail moth work:			
Labor	$1,290 53		
Supplies	167 80		
		1,458 33	
Road repairs:			
Labor	$8,480 12		
Supplies	5,236 37		
		13,716 49	
Street lighting		14,954 19	
General supplies		1,843 07	
Horses, carriages, automobiles, etc.		984 06	
Repairs		374 00	
Telephones		86 10	
Physicians' services		55 00	
Water rates		22 19	
Express		14 39	
Lighting buildings		13 27	
Postage		3 00	
			53,774 58
Amounts carried forward			$197,165 00 $440,900 00

Amounts brought forward		$197,165 00	$440,900 00
Mystic Valley Parkway:			
General labor	$17,735 08		
Gypsy and brown-tail moth work:			
Labor	$1,750 00		
Supplies	167 81		
	1,917 81		
Road repairs:			
Labor	$9,042 26		
Supplies	5,406 49		
	14,448 75		
Street lighting	5,585 18		
General supplies	2,461 99		
Horses, carriages, automobiles, etc.	1,443 04		
Telephones	81 85		
Physicians' services	64 50		
Repairs	61 66		
Water rates	15 35		
Express and freight	13 99		
Keep of horses	10 20		
Postage	4 75		
Advertising	2 20		
		43,846 35	
Revere Beach Parkway:			
General labor	$22,922 32		
Gypsy and brown-tail moth work:			
Labor	$290 61		
Supplies	4 35		
	294 96		
Road repairs:			
Labor	$3,413 39		
Supplies	5,862 88		
	9,276 27		
Street lighting	11,737 54		
Horses, carriages, automobiles, etc.	3,245 05		
General supplies	2,742 90		
Repairs	814 27		
Power for draw	342 20		
Damages to motor vehicle	253 75		
Water rates	5 88		
Keep of horses	3 17		
Postage	3 00		
		51,641 31	
Neponset River Parkway:			
General labor	$1,330 25		
Gypsy and brown-tail moth work:			
Labor	243 47		
		1,573 72	
Nahant Beach Parkway:			
General labor	$6,764 83		
Road repairs:			
Labor	76 37		
Street lighting	980 00		
General supplies	525 02		
Keep of horses	265 94		
Repairs	91 87		
Auto expense	31 23		
		8,735 26	
Fresh Pond Parkway:			
General labor	$2,170 10		
Gypsy and brown-tail moth work:			
Labor	139 66		
Amounts carried forward	$2,309 76	$302,961 64	$440,900 00

Amounts brought forward	$2,309 76	$302,961 64	$440,900 00
Road repairs:			
Labor	27 50		
Street lighting	455 00		
Auto expense	122 92		
		2,915 18	
Furnace Brook Parkway:			
General labor	$7,526 88		
Gypsy and brown-tail moth work:			
Labor	504 05		
Road repairs:			
Labor	$692 44		
Supplies	1,157 77		
	1,850 21		
Street lighting	2,478 49		
General supplies	202 79		
Water rates	7 00		
Lighting buildings	5 73		
Repairs	90		
		12,576 05	
Winthrop Parkway:			
General labor	$563 98		
Road repairs:			
Labor	25 50		
Street lighting	392 28		
		981 76	
Lynnway:			
General labor	$8,077 67		
Road repairs:			
Labor	$45 12		
Supplies	77 52		
	122 64		
General supplies	686 98		
Power for lighting and operating draw	523 40		
Street lighting	210 00		
Advertising	57 65		
Water rates	11 64		
Maps and books	7 80		
Traveling	4 00		
Keep of horses	3 17		
Postage	3 00		
		9,707 95	
Lynn Fells Parkway:			
General labor	$3,088 21		
Gypsy and brown-tail moth work:			
Labor	55 41		
Road repairs:			
Labor	$471 69		
Supplies	44 00		
	515 69		
Street lighting	1,651 76		
General supplies	145 09		
Auto expense	82 18		
		5,538 34	
Middlesex Fells Roads:			
General labor	$3,798 31		
Road repairs:			
Labor	$6,175 20		
Supplies	4,952 65		
	11,127 85		
Amounts carried forward	$14,926 16	$334,680 92	$440,900 00

Amounts brought forward			$14,926 16	$334,680 92	$440,900 00
Street lighting			2,914 24		
Horses, carriages, automobiles, etc.			416 11		
General supplies			328 31		
Stationery and printing			61 46		
Physicians' services			36 00		
				18,682 28	
Alewife Brook Parkway:					
General labor			$12,189 79		
Gypsy and brown-tail moth work:					
Labor			240 17		
Road repairs:					
Labor	$508 05				
Supplies	614 24				
			1,122 29		
General supplies			3,038 43		
Horses, carriages, automobiles, etc.			921 20		
Street lighting			913 84		
Repairs			101 37		
Express			5 88		
				18,532 97	
Woburn Parkway:					
General labor			$4,575 24		
Gypsy and brown-tail moth work:					
Labor			208 81		
Road repairs:					
Labor	$157 97				
Supplies	50 00				
			207 97		
General supplies			595 48		
Auto expense			258 83		
Water rates			12 00		
				5,858 33	
Dedham Parkway:					
Auto expense			$693 75		
Repairs			59 68		
General supplies			26 46		
				779 89	
Hammond Pond Parkway:					
General labor			$3,514 75		
Telephones			29 75		
Auto expense			4 25		
				3,548 75	
West Roxbury Parkway:					
General labor			$1,609 99		
Gypsy and brown-tail moth work:					
Labor			327 14		
Road repairs:					
Labor			131 84		
General supplies			8 33		
				2,077 30	
Neponset River Bridge:					
General labor			$8,191 47		
General supplies			878 71		
Repairs			318 60		
Street lighting			225 00		
Telephones			51 45		
Keep of horses			3 17		
Postage			3 00		
				9,671 40	
					393,831 84
Balance					$47,068 16

Special Appropriations.

Appropriation (chapter 629, Items 638 and 244, Acts of 1920)				$95,000 00

Expenditures.

Middlesex Fells Parkway:				
Construction:				
Contract, Simpson Bros.			$2,636 01	
West Roxbury Parkway:				
Construction:				
Contracts:				
Coleman Bros.	$49,778 72			
Alexander Palladino	822 86			
		$50,601 58		
Labor and materials		1,415 74		
			$52,017 32	
Engineering:				
Services		$2,667 01		
Expenses		35 54		
			2,702 55	
Advertising			172 65	
				54,892 52
				$57,528 53
Amounts charged to Dec. 1, 1920				16,369 87
				73,898 40
Balance				$21,101 60

Retaining Wall, Everett.

Appropriation (chapter 378, Acts of 1921)				$2,500 00

Expenditures.

Construction:				
Contract:				
Alexander Palladino			$1,130 39	
Labor and materials			6 00	
				$1,136 39
Engineering:				
Services			$175 44	
Expenses			3 40	
				178 84
Advertising				45 80
				1,361 03
Balance				$1,138 97

Winthrop Parkway.

Appropriation (chapter 397, Acts of 1921)				$225,000 00

Expenditures.

Construction:				
Labor and materials			$73 67	
Amounts carried forward			$73 67	$225,000 00

Amounts brought forward		$73 67	$225,000 00
Engineering:			
Services	$753 16		
Expenses	2 20		
		755 36	
Advertising		51 30	
			880 33
Balance			$224,119 67

Dedham Parkway.

Appropriation (chapter 502, Item 634c, Acts of 1921)	$7,000 00

EXPENDITURES.

Construction:			
Labor and materials		$5,431 15	
Engineering:			
Services	$101 94		
Expenses	1 70		
		103 64	
			5,534 79
Balance			$1,465 21

CHARLES RIVER BASIN MAINTENANCE.

Maintenance of Parks and Water Areas.

Appropriation	$111,400 00

EXPENDITURES.

General labor	$32,124 69		
Teaming	235 19		
		$32,359 88	
Police:			
Pay rolls	$50,638 76		
Miscellaneous	4,958 50		
		55,597 26	
Street lighting		5,347 24	
General supplies		3,190 36	
Dolphins		2,820 09	
Horses, carriages, automobiles, etc.		2,692 60	
Lighting buildings		1,266 15	
Water rates		562 73	
Stationery and printing		399 99	
Repairs		382 64	
Telephones		260 06	
Keep of horses		20 79	
Express		19 79	
Postage		14 00	
Advertising		10 65	
Damage to property		10 19	
			104,954 42
Balance			$6,445 58

Maintenance and Operation of Locks, Gates and Drawbridges.

Appropriation			$80,000 00
EXPENDITURES.			
General labor	$44,351 93		
Teaming	6,576 40		
		$50,928 33	
Ice-breaking:			
Labor	$4,673 76		
Supplies	1,447 40		
		6,121 16	
Coal		4,751 33	
Repairs		4,045 26	
General supplies		3,337 83	
Electric power		1,626 98	
Lighting lock-gate houses and sluices		602 89	
Heating		473 18	
Automobile expense		279 62	
Telephones		116 21	
Stationery and printing		48 78	
Keep of horses		19 01	
Water rates		4 40	
Traveling		1 90	
Postage		1 00	
Express		38	
			72,358 26
Balance			$7,641 74

Special Item — Dredging Canals — Charles River Basin.

Appropriation (chapter 203, item 629½, Acts of 1921)			$10,000 00
EXPENDITURES.			
Construction:			
Contract, Wm. S. Rendle		$6,354 61	
Engineering:			
Services	$395 40		
Expenses	60		
		396 00	
			6,750 61
Balance			$3,249 39

NANTASKET BEACH MAINTENANCE.

Appropriation			$71,000 00
EXPENDITURES.			
General labor		$23,174 33	
Road repairs:			
Labor	$5,681 91		
Supplies	2,555 14		
		8,237 05	
Amounts carried forward		$31,411 38	$71,000 00

Amounts brought forward		$31,411 38	$71,000 00
Police:			
Pay rolls	$19,687 03		
Miscellaneous	3,432 63		
		23,119 66	
General supplies		3,838 53	
Street lighting		1,603 20	
Auto expense		1,032 26	
Keep of horses		877 51	
Water rates		602 61	
Rent		540 00	
Express and freight		63 12	
Telephones		221 33	
Repairs		201 67	
Stationery and printing		163 13	
Physicians' services, etc.		85 00	
Postage		29 00	
Rent of drain pipe		6 00	
Traveling		3 22	
			63,797 62
Balance			$7,202 38

Wellington Bridge Maintenance.

Appropriation			$15,000 00
Expenditures.			
Labor		$11,821 47	
Street lighting		2,142 67	
General supplies		589 41	
Telephones		94 90	
Repairs		80 86	
Keep of horses		12 67	
Auto expense		12 17	
Stationery and printing		8 98	
Postage		1 00	
			14,764 13
Balance			$235 87

Bunker Hill Maintenance.

Appropriation			$10,000 00
Expenditures.			
General labor		$3,999 30	
Police:			
Pay rolls	$4,185 78		
Miscellaneous	13 99		
		4,199 77	
General supplies		445 10	
Lighting buildings		256 55	
Telephones		181 63	
Repairs		75 95	
Water rates		23 10	
Stationery and printing		3 70	
Auto expense		2 30	
			9,187 40
Balance			$812 60

Bunker Hill — Special Improvement.

Appropriation (chapter 225, Acts of 1920)			$25,000 00
Expenditures.			
Improvement:			
Contracts:			
Jas. H. Fannon	$2,445 86		
W. A. Snow Iron Works, Inc.	2,262 13		
		$4,707 99	
Engineering:			
Services	$101 00		
Expenses	40		
		101 40	
Advertising		76 50	
			$4,885 89
Amounts charged to Dec. 1, 1920			20,114 11
			$25,000 00

Metropolitan Parks Expense Fund.

Receipts, Dec. 1, 1920, to Dec. 1, 1921.

Bath-houses:		
Revere Beach, sale of bath tickets	$30,814 60	
Nantasket Beach, sale of bath tickets	18,944 30	
Nahant Beach, sale of bath tickets	8,234 05	
Magazine Beach, sale of bath tickets	3,662 70	
Blue Hills, sale of bath tickets	450 70	
		$62,106 35
Rentals:		
Buildings	$22,152 98	
Roller coaster and merry-go-round	3,500 00	
Lunch stands and refectories	2,660 00	
Boathouse sites	1,940 00	
Day rentals, Riverside Recreation Grounds	1,450 00	
Street railway location	1,246 48	
Automobile stands	1,100 00	
Houses	1,094 25	
Land	988 83	
Boats	693 95	
Ducts	687 99	
Gas main location	100 00	
Dance hall, Nantasket	50 00	
		37,664 48
Sales:		
Wood	$8,638 85	
Discarded articles	1,069 46	
Hay and grass	651 45	
Old metal, lumber, paper, etc.	254 34	
Filling material, gravel, etc.	180 61	
Sanitary napkins	159 52	
Coffee urn	45 00	
Barrels	29 75	
Typewriter	20 00	
Shrubs	16 20	
Stationery	15 21	
Posts, stakes, etc.	14 90	
Plans	9 14	
Vegetables	9 00	
Gasoline	58	
		11,114 01
Amount carried forward		$110,884 84

Amount brought forward	$110,884 84
Interest	25,115 38
Court fines	10,106 00
Steamer chair and umbrella privilege	6,868 00
Patrolling Water Board land	5,139 50
Admissions, Bunker Hill Monument	3,469 20
Sidewalk and entrance construction	1,802 40
Bags, carboys, etc., returned	760 09
Souvenir privilege, Bunker Hill Monument	750 00
Spraying land in Winchester	600 00
Pay closets	575 50
Damage to property	411 57
Refund on tickets	400 96
Light and water furnished	240 52
Removal of garbage	210 00
Shortage in delivery (coal)	71 77
Replaced keys and checks	53 90
Newspaper licenses	40 00
Telephone tolls	39 95
Refunds	26 89
Money found	25 19
	$167,591 66

Expenditures Dec. 1, 1920, to Dec. 1, 1921.

General expense:		
Interest	$2,537 19	
Maps	495 00	
Advertising	48 10	
		$3,080 29
Police:		
Repairs to uniforms	$854 71	
Rewiring police signal system	497 83	
Side car for motorcycle	125 00	
		1,477 54
Engineering:		
Tickets	$210 62	
Telephone	8 87	
		219 49
Blue Hills Reservation:		
Signs	$156 52	
Repairs to buildings	54 44	
Advertising	17 50	
Flags	14 40	
Bath-house tickets	8.36	
		251 22
Middlesex Fells Reservation:		
Repairs to buildings	$970 75	
Forestry work	599 87	
Flags	57 60	
Towels	29 55	
Advertising	21 05	
		1,678 82
Revere Beach Reservation:		
Bath-house:		
Pay rolls	$22,076 88	
Bathing suits	4,983 51	
Coal	2,297 18	
Lighting	800 52	
Stationery and printing	471 44	
Water rates	369 82	
Amounts carried forward	$30,999 35	$6,707 36

Amounts brought forward	$30,999 35	$6,707 36
Engine room	315 57	
Bathing caps	243 75	
Tickets, etc.	197 84	
Rubber hose	160 23	
Neck bands	157 62	
Ice	153 54	
Stockings	135 00	
Soap, etc.	129 40	
Locks and keys	85 77	
Findings	84 17	
Towels	83 42	
Baskets	79 06	
Hardware	64 05	
Brooms, mops, etc.	62 08	
Lumber	54 83	
Bunting	52 18	
Boiler treatment	46 53	
Rubber binding	40 57	
Medicines and attendance	37 91	
Repairs	34 35	
Telephones	32 72	
Uniforms	26 50	
Rental of typewriter	24 00	
Cover for laundry	23 85	
Paint	21 02	
Renewal of bond	20 00	
Dials for clock	17 64	
Flags	16 21	
Sanitary napkins	14 70	
Carfares	12 40	
Metal polish	12 00	
Drilling	6 08	
Postage	4 95	
Rubber stamps and pad	4 44	
Combs	3 32	
Express	79	
Miscellaneous	4 24	
		33,462 08
Stony Brook Reservation:		
Water rates	$15 18	
Repairs	3 55	
		18 73
Charles River Upper Division:		
Repairs	$474 30	
Granolithic walks	125 10	
Refund of deposit for entrance construction	100 00	
Rental of land	55 00	
Water rates	24 20	
		778 60
Neponset River Reservation:		
Back-stop at ball field		76 75
Quincy Shore Reservation:		
Addition to substation	$729 63	
Refund on entrance construction	23 00	
		752 63
Amount carried forward		$41,796 15

Amount brought forward			$41,796 15
Winthrop Shore Reservation:			
Building sea wall and other work:			
Contract, Harvey L. Maney Co.	$7,775 15		
Materials	975 77		
		$8,750 92	
Advertising		118 15	
Printing contracts		50 16	
			8,919 23
Charles River Lower Basin:			
Doors for garage shed		$967 55	
Flags		86 40	
Signs		71 62	
			1,125 57
Cambridge Parkway:			
Magazine Beach Bath-house:			
Pay rolls	$2,299 26		
Repairs	740 01		
Locks and keys	708 14		
Towels	549 54		
Ticket choppers	200 00		
Lungmotor outfit	147 00		
Hardware	128 38		
Mirrors	115 00		
Brooms, mops, etc.	101 84		
Baskets	97 92		
Stationery and printing	74 26		
Paper towels	68 53		
Toilet paper	65 91		
Cash register	65 00		
Tickets, etc.	55 08		
Bathing suits	54 32		
Engine room	49 18		
Stockings	33 75		
Water rates	32 60		
Brass checks	32 53		
Bathing caps	32 50		
Neck bands	31 52		
Window guards	30 00		
Chairs	24 00		
Electric bell	21 81		
Lighting	14 14		
Stool	12 75		
Medicines and attendance	11 50		
Wringers	10 29		
Sewer pipe	6 59		
Lumber, etc.	6 26		
Glass	67		
		$5,820 28	
Signs		40 32	
			5,860 60
Blue Hills Parkway:			
Refund, entrance construction			33 12
Middlesex Fells Parkway:			
Repairs to Wellington bridge		$541 70	
Refunds, entrance construction		365 80	
Granolithic walks:			
Contract, Alexander Palladino		301 30	
Advertising		60 00	
Telephone		1 80	
			1,270 60
Amount carried forward			$59,005 27

Amount brought forward		$59,005 27
Mystic Valley Parkway:		
Land	$175 00	
Refund, entrance construction	97 03	
Entrance construction	9 64	
		281 67
Revere Beach Parkway:		
Entrance construction		43 81
Nahant Beach Parkway:		
Bath-house:		
Pay rolls	$6,072 28	
Towels	973 92	
Bathing suits	647 11	
Coal	406 55	
Lumber	187 76	
Bathing caps	162 50	
Lighting	147 30	
Neck bands	126 10	
Telephones	87 29	
Stockings	67 50	
Tickets, etc.	57 34	
Repairs	42 74	
Locks and keys	37 74	
Hardware	28 53	
Soap, etc.	27 52	
Medicines and attendance	26 43	
Ice	23 41	
Paint	22 92	
Brooms	15 68	
Flags	15 13	
Sanitary napkins	14 70	
Batteries	8 89	
Ink	8 08	
Bond renewal	6 00	
Clock dial	4 10	
Bicarbonate of soda	3 92	
Postage	3 00	
Gloves	75	
		9,225 19
Furnace Brook Parkway:		
Refund, entrance construction		12 25
Lynnway:		
Wiring Saugus River bridge		318 20
Lynn Fells Parkway:		
Entrance construction		25 52
Woburn Parkway:		
Entrance construction		84 33
West Roxbury Parkway:		
Grading		338 17
Old Colony Parkway:		
Water rates	$12 10	
Telephone	40	
		12 50
Amount carried forward		$69,346 91

Amount brought forward			$69,346 91
Bunker Hill Monument:			
Erecting fence: —			
Contract, W. A. Snow Iron Works, Inc.		$1,711 87	
Maintenance pay rolls		1,216 85	
Advertising		31 80	
			2,960 52
Nantasket Beach Reservation:			
Bath-house:			
Pay rolls	$13,590 39		
Coal	3,480 65		
Bathing suits	1,511 00		
Water rates	1,006 60		
Lumber, etc.	333 78		
Engine room	299 35		
Stationery	271 23		
Hardware	175 38		
Ice	136 84		
Stockings	135 00		
Toilet paper	126 91		
Towels	124 95		
Lighting	106 01		
Bathing caps	105 94		
Soap, etc.	105 77		
Medicines and attendance	63 58		
Neck bands	63 05		
Blankets	55 34		
Mangle apron	52 07		
Proportioning steam charges	50 00		
Drilling	43 59		
Paint	39 49		
Repairs	38 45		
Brooms, mops, etc.	38 11		
Tickets	35 31		
Telephones	31 30		
Pails	13 59		
Badges	7 94		
Bond renewal	6 00		
Cement	4 45		
Mats	4 39		
Repairs to clock	4 25		
Mirror	4 20		
Findings	4 08		
Time stamp	3 00		
		$22,071 99	
Repairs to buildings		5,945 77	
Resurfacing parking space		2,118 35	
			30,136 11
			$102,443 54

Summary of General Expense for Year ending Nov. 30, 1921.

	Parks System Maintenance.	Parks Boulevard Maintenance.	Parks Expense Fund.	Parks Loan Fund.	Parks Loan Fund, Series II.	Totals.
Commissioners	$2,500 00	$2,500 00	–	–	–	$5,000 00
Office salaries	10,452 69	10,653 64	–	–	–	21,106 33
Engineering	12,580 11	11,041 95	$219 49	–	–	23,841 55
Police	189,171 23	83,895 08	1,477 54	–	–	274,543 85
Rent, lighting and care, Boston office	4,678 33	4,467 04	–	–	–	9,145 37
Miscellaneous	3,708 74	5,417 97	–	–	–	9,126 71
Totals	$223,091 10	$117,975 68	$1,697 03	–	–	$342,763 81

Summary of Expenditures for Year ending Nov. 30, 1921.

	Metropolitan Parks Loan Fund.	Metropolitan Parks Loan Fund, Series II.	Metropolitan Parks System Maintenance.	Metropolitan Parks Boulevard Maintenance.	Metropolitan Parks Expense Fund.	Special Appropriations, Repairs, Construction and Investigations.	Band Concerts.	Totals.
Reservations:								
Blue Hills	–	–	$115,102 68	–	$513 72	–	$778 00	$116,394 40
Beaver Brook	–	–	2,865 17	–	–	–	–	2,865 17
Charles River, Upper Division	$200 00	–	73,590 60	–	938 35	$500 00	2,950 00	78,178 95
Lynn Shore	–	–	17,953 20	–	–	–	–	17,953 20
Middlesex Fells	–	–	95,429 88	–	1,678 82	–	3,686 20	100,794 90
Mystic River	1,515 00	–	18,619 45	–	–	8,614 06	–	28,748 51
Neponset River	–	–	1,640 07	–	76 75	–	–	1,716 82
Quincy Shore	–	–	14,725 89	–	752 63	–	–	15,478 52
Revere Beach	–	–	56,777 73	–	33,462 08	–	2,660 00	92,899 81
Riverside Recreation Grounds	–	–	6,293 02	–	–	–	–	6,293 02
Stony Brook	–	–	11,050 54	–	18 73	–	–	11,069 27
Winthrop Shore	–	–	7,348 39	–	8,919 23	–	–	16,267 62
General expense	–	–	236,476 34	–	–	–	16 95	236,493 29
Totals	$1,715 00	–	$657,872 96	–	$46,360 31	$9,114 06	$10,091 15	$725,153 48

Cambridge Parkway	–	–	$48,809 60	–	$5,860 60	–	–	$54,670 20
Parkways:								
Alewife Brook	–	–	–	$18,532 97	–	–	–	$18,532 97
Blue Hills	–	–	–	25,414 74	$33 12	–	–	25,447 86
Dedham	–	$3,354 64	–	779 89	–	$5,534 79	–	9,669 32
Fresh Pond	–	–	–	2,915 18	–	–	–	2,915 18
Furnace Brook	–	303 72	–	12,576 05	12 25	–	–	12,892 02
Hammond Pond	–	–	–	3,548 75	–	–	–	3,548 75
Lynn Fells	–	–	–	5,538 34	25 52	–	–	5,563 86
Lynnway	–	–	–	9,707 95	318 20	–	–	10,026 15
Middlesex Fells	–	–	–	53,774 58	1,270 60	2,636 01	–	57,681 19
Middlesex Fells Roads	–	12 75	–	18,682 28	–	–	–	18,695 03
Mystic Valley	–	998 50	–	43,846 35	281 67	–	–	45,126 52
Nahant Beach	–	–	–	8,735 26	9,225 19	–	$1,527 50	19,487 95
Neponset River	–	–	–	1,573 72	–	–	–	1,573 72
Nonantum Road	–	1,976 35	–	–	–	–	–	1,976 35
Old Colony	–	9,764 08	–	–	12 50	–	–	9,776 58
Quannapowitt	–	336 00	–	–	–	–	–	336 00
Revere Beach	–	–	–	51,641 31	43 81	1,361 03	–	53,046 15
West Roxbury	–	7,781 04	–	2,077 30	338 17	54,892 52	–	65,089 03
Winthrop	–	700 00	–	981 76	–	880 33	–	2,562 09
Woburn	–	650 00	–	5,858 33	84 33	–	–	6,592 66
Neponset Bridge	–	3,589 06	–	9,671 40	–	–	–	13,260 46
General expense	–	–	–	117,975 68	3,080 29	–	–	121,055 97
Totals	–	$29,466 14	–	$393,831 84	$14,725 65	$65,304 68	$1,527 50	$504,855 81

Summary of Expenditures for Year ending Nov. 30, 1921 — Concluded.

	Metropolitan Parks Loan Fund.	Metropolitan Parks Loan Fund, Series II.	Metropolitan Parks System Maintenance.	Metropolitan Parks Boulevard Maintenance.	Metropolitan Parks Expense Fund.	Special Appropriations, Repairs, Construction and Investigations.	Band Concerts.	Totals.
Nantasket Beach Reservation	–	–	–	–	$30,204 74	$63,797 62	$7,379 71	$101,382 07
Wellington Bridge	–	–	–	–	–	14,764 13	–	14,764 13
Charles River Basin	–	–	–	–	1,255 12	55 00[1] 177,312 68[2] 6,750 61	–	185,373 41
Bunker Hill Monument	–	–	–	–	2,960 52	9,187 40 4,885 89	192 50	17,226 31
Charles River Bridges	–	–	–	–	–	625 68[1]	–	625 68
Grand totals	$1,715 00	$29,466 14	$706,682 56	$393,831 84	$103,063 97	$351,797 75	$19,190 86	$1,605,748 12

[1] Loan.

[2] Maintenance.

WATER AND SEWERAGE DIVISIONS.

The financial abstract of the receipts, disbursements, assets and liabilities of the Metropolitan District Commission, Water and Sewerage Divisions, for the State fiscal year, beginning with December 1, 1920, and ending with November 30, 1921, was, in accordance with the requirements of section 100, chapter 92 of the General Laws, presented to the General Court in January last, and a copy of this financial abstract is printed as Appendix No. 5.

As required by said section a detailed statement of its doings for the calendar year 1921, in relation to the Metropolitan Water and Sewerage Works, is herewith presented.

WATER WORKS.

Construction.

(1) Water Loans — Receipts and Payments.

Total loans authorized to January 1, 1922		$45,685,000 00
Receipts from the sales of property applicable to the construction and acquisition of works:		
For the period prior to January 1, 1921	$264,903 63	
For the year ending December 31, 1921	9,232 22	
		274,135 85
Receipt from the town of Swampscott for admission to district (St. 1909, c. 320)		90,000 00
Total amount authorized to January 1, 1922		$46,049,135 85
Amounts approved by Board for payments out of Water Loan Fund:		
Payments prior to January 1, 1921	$43,287,875 89	
Approved for year ending December 31, 1921	156,729 39	
		43,444,605 28
Amount authorized but not expended January 1, 1922		$2,604,530 57

(2) Total Water Debt, December 31, 1921.

Water Loan Outstanding, Sinking Fund and Debt.

Bonds issued by the Treasurer of the Commonwealth:	
Sinking fund bonds (3 and 3½ per cent)	$41,398,000 00
Serial bonds (3½, 4 and 4¼ per cent)	1,549,000 00
Total bond issue to December 31, 1921	$42,947,000 00

Serial bonds paid prior to January 1, 1921 .	$221,000 00	
Serial bonds paid in 1921	44,000 00	
		$265,000 00
Total bond issue outstanding December 31, 1921 . .		$42,682,000 00
Gross water debt		$42,682,000 00
Sinking fund December 31, 1921		18,147,014 21
Net water debt December 31, 1921		$24,534,985 79

A decrease for the year of $1,237,849.06.

(3) Metropolitan Water Loan and Sinking Fund, December 31, 1921.

Year.	Authorized Loans	Bonds issued (Sinking Fund).	Bonds issued (Serial Bonds).	Sinking Fund.
1895	$27,000,000	$5,000,000	–	$226,286 05
1896	–	2,000,000	–	699,860 70
1897	–	6,000,000	–	954,469 00
1898	–	4,000,000	–	1,416,374 29
1899	–	3,000,000	–	1,349,332 97
1900	–	1,000,000	–	1,573,619 72
1901	13,000,000	10,000,000	–	1,662,426 95
1902	–	3,500,000	–	2,256,803 81
1903	–	1,500,000	–	2,877,835 59
1904	–	2,500,000	–	3,519,602 92
1905	–	650,000	–	4,207,045 69
1906	500,000	1,350,000	–	4,897,822 62
1907	–	–	–	5,643,575 69
1908	398,000	–	–	6,419,283 28
1909	900,000	398,000	–	7,226,262 31
1910	80,000	500,000	–	8,089,902 91
1911	212,000	–	$200,000	8,953,437 44
1912	600,000	–	190,000	9,829,356 80
1913	108,000	–	–	10,767,701 68
1914	–	–	258,000	11,533,453 45
1915	–	–	490,000	12,491,245 25
1916	–	–	66,000	13,268,199 36
1917	–	–	150,000	14,036,278 88
1918	115,000	–	–	14,870,834 84
1919	67,000	–	161,000	15,904,545 14
1920	2,705,000	–	34,000	16,953,165 15
1921	–	–	–	18,147,014 21
	$45,685,000	$41,398,000	$1,549,000	–

(4) Water Assessment, 1921.

The following water assessment was made by the Treasurer of the Commonwealth upon the various municipalities: —

Sinking fund requirements		$234,665 68
Serial bonds		44,000 00
Interest		1,488,635 95
Maintenance:		
Appropriated by Legislature	$867,960 00	
Less balance on hand	5,535 03	
		862,424 97
Total water assessment for 1921		$2,969,726 60

In accordance with section 26, chapter 92 of the General Laws, the proportion to be paid by each city and town is based one-third in proportion to their respective valuations and the remaining two-thirds in proportion to their respective water consumption for the preceding year, except that but one-fifth of the total valuation and no consumption has been taken for the city of Newton, as it has not been supplied with water from the metropolitan works.

The division of the assessment for 1921 was as follows: —

Cities and Towns.	Assessment.	Cities and Towns.	Assessment.
Arlington	$24,635 28	Nahant	$4,399 54
Belmont	14,744 88	Newton	7,231 75
Boston	1,958,528 33	Quincy	85,289 92
Chelsea	62,997 73	Revere	39,177 67
Everett	64,699 16	Somerville	133,989 84
Lexington	10,014 00	Stoneham	13,974 36
Malden	57,120 28	Swampscott	15,470 68
Medford	40,358 42	Watertown	38,430 83
Melrose	24,093 56	Winthrop	19,712 42
Milton	14,857 95		$2,629,726 60

(5) Supplying Water to Cities and Towns outside of District and to Water Companies.

Sums have been received during the year 1921 under the provisions of the metropolitan water act, for water furnished, as follows: —

Town of Framingham	$4,897 34
United States government (for Peddock's Island)	1,336 10
Westborough State Hospital	2,345 19
	$8,578 63

The sums so received prior to March 23, 1907, were annually distributed among the cities and towns of the district, but since that date, in accordance with the provisions of chapter 238 of the Acts of 1907, the sums so received have been paid into the sinking fund.

(6) Expenditures for the Different Works.

The following is a summary of the expenditures made in the various operations for the different works: —

Construction and Acquisition of Works.	For the Year ending December 31, 1921.	
Administration applicable to all parts of the construction and acquisition of the works		$2,914 00
Distribution system:		
Northern high service:		
Section 48 (reinforcement of the northern high-service pipe lines)	$179 86	
Section 49 (reinforcement of the northern high-service pipe lines)	318 59	
Section 50 (reinforcement of the northern high-service pipe lines)	1,429 22	
Additional pumping machinery at Spot Pond pumping station	252 31	
Southern high service:		
Additional pumping machinery at Chestnut Hill pumping station of the southern high service	100,150 98	
Northern extra high service:		
Arlington Reservoir in Arlington, Mass.	10,485 24	
Southern extra high service:		
Section 44 (additional water supply for the town of Milton and the Hyde Park district of the city of Boston)	6,042 23	
Weston Aqueduct supply mains, Section 9	784 41	
Meters and connections	3,977 18	
		123,620 02
Acquisition, existing water works (Spot Pond case)		22,647 98
Amount carried forward		$149,182 00

Construction and Acquisition of Works.		For the Year ending December 31, 1921.
Amount brought forward		$149,182 00
Stock—pipes, valves, castings, etc., purchased and sent first to storage yards, and later transferred, as needed, to the various parts of the work: —		
Amount received	$8,214 12	
Transferred from storage yards to the various sections of the work and included in costs of special works	666 73	
		7,547 39
		$156,729 39
Amount charged from beginning of work to January 1, 1921		43,287,875 89
Total for construction and acquisition of works to January 1, 1922		$43,444,605 28

Maintenance and Operation.		For the Year ending December 31, 1921.
Administration		$13,733 30
General supervision		40,955 74
Taxes and other expenses		49,103 93
Wachusett Department:		
Superintendence	$12,227 30	
Reservoir	24,487 39	
Forestry	13,636 37	
Protection of supply	15,043 63	
Buildings and grounds	8,557 94	
Wachusett Dam	8,826 23	
Wachusett Aqueduct	9,845 11	
Clinton sewerage system:		
Pumping station	3,552 36	
Sewers, screens and filter beds	9,335 75	
Sanitary inspection	1,466 34	
Swamp drainage	11,326 26	
Power plant	19,190 27	
Wachusett-Sudbury power transmission line	93 99	
Payments under industrial accident law and special benefit appropriations	43 50	
		137,632 44
Sudbury Department:		
Superintendence, Framingham office	$14,060 05	
Ashland Reservoir	3,257 91	
Hopkinton Reservoir	3,492 00	
Whitehall Reservoir	3,797 45	
Framingham Reservoirs Nos. 1, 2 and 3	14,559 81	
Sudbury Reservoir	12,408 05	
Lake Cochituate	11,316 02	
Marlborough Brook filters	4,175 29	
Pegan filters	7,384 92	
Sudbury and Cochituate watersheds	2,156 49	
Sanitary inspection	3,350 96	
Amounts carried forward	$79,958 95	$241,425 41

Maintenance and Operation.	For the Year ending December 31, 1921.	
Amounts brought forward	$79,958 95	$241,425 41
Sudbury Department — *Con.*		
Cochituate Aqueduct	3,873 60	
Sudbury Aqueduct	9,220 74	
Weston Aqueduct	8,736 92	
Forestry	13,459 36	
Power plant	12,604 00	
Payments under industrial accident law and special benefit appropriations	26 00	
Improvement and protection of water supplies	3 67	
		127,883 24
Distribution Department:		
Superintendence	$9,961 51	
Pumping service:		
Superintendence	8,623 37	
Payments under industrial accident law and special benefit appropriations	520 32	
Arlington pumping station, pumping service	17,409 88	
Chestnut Hill low-service pumping station, pumping service No. 2	115,730 68	
Chestnut Hill high-service pumping station, pumping service No. 1	39,570 92	
Spot Pond pumping station, pumping service	31,903 08	
Hyde Park pumping station, pumping service	11,872 69	
Arlington stand pipe	89	
Bear Hill Reservoir	443 90	
Chestnut Hill Reservoir and grounds	23,236 68	
Fells Reservoir	1,987 25	
Forbes Hill Reservoir	2,769 70	
Mystic Lake, conduit and pumping station	15,768 46	
Mystic Reservoir	462 37	
Waban Hill Reservoir	995 75	
Weston Reservoir	5,462 12	
Spot Pond	10,213 43	
Buildings at Spot Pond	294 90	
Pipe lines:		
Low service	45,734 46	
Northern high service	10,408 81	
Northern extra high service	313 23	
Southern high service	12,970 36	
Southern extra high service	379 84	
Supply pipe lines	2,581 34	
Buildings at Chestnut Hill Reservoir	7,588 48	
Chestnut Hill pipe yard	2,121 74	
Glenwood pipe yard and buildings	3,345 77	
Stables	13,318 50	
Venturi meters	3,926 87	
Measurement of water	3,329 97	
Arlington pumping station, buildings and grounds	349 74	
Hyde Park pumping station, buildings and grounds	365 25	
Fisher Hill Reservoir	2,805 49	
Bellevue Reservoir	104 00	
Payments under industrial accident law and special benefit appropriations	1,523 17	
		408,394 92
Total for maintaining and operating works		$777,703 57

(7) Detailed Financial Statement under Metropolitan Water Act.

The Commissioner herewith presents, in accordance with the requirements of the metropolitan water act, a detailed statement of the expenditures and disbursements, receipts, assets and liabilities for the year 1921.

(*a*) *Expenditures and Disbursements.*

The total amount of the expenditures and disbursements on account of construction and acquisition of works for the year beginning January 1, 1921, and ending December 31, 1921, was $156,729.39, and the total amount from the time of the organization of the Metropolitan Water Board, July 19, 1895, to December 31, 1921, has been $43,444,605.28.

For maintenance and operation the expenditures for the year were $777,703.57.

The salaries of the commissioners, and the other expenses of administration, have been apportioned to the construction of the works and to the maintenance and operation of the same, and appear under each of those headings.

The following is a division of the expenditures according to their general character: —

General Character of Expenditures.	For the Year ending December 31, 1921.	
Construction of Works and Acquisition by Purchase or Taking.		
Administration.		
Commissioners	$600 00	
Secretary	277 00	
Clerks and stenographers	1,429 50	
Stationery and printing	84 05	
Postage, express and telegrams	10 00	
Alterations and repairs of building	3 15	
Telephone, lighting, heating, water and care of building	303 97	
Rent and taxes, main office	200 43	
Miscellaneous expenses	5 90	
		$2,914 00
Engineering.		
Chief engineer	$1,233 89	
Principal assistant engineers	2,836 20	
Engineering assistants	4,960 92	
Inspectors	1,903 33	
Amounts carried forward	$10,934 34	$2,914 00

General Character of Expenditures.	For the Year ending December 31, 1921.	
Amounts brought forward	$10,934 34	$2,914 00
Engineering — Con.		
Railroad and street car travel	12 86	
Stationery and printing	52 09	
Engineering and draughting supplies	4 32	
Books, maps and photographic supplies	4 05	
Alterations and repairs of building, main office	9 45	
Telephone, lighting, heating, water and care of buildings, main office	911 98	
Rent and taxes, main office	601 30	
Miscellaneous expenses	19 15	
		12,549 54
Construction.		
Preliminary work:		
Advertising		85 60
Contracts, distribution system:		
Hodge Boiler Works, Contract 5, for furnishing and delivering street chambers for Venturi meter register	$2,628 00	
Ames Iron Works, Contract 4, for furnishing 35 kilowatt electric lighting unit for Chestnut Hill Low Service Pumping Station No. 2	3,649 00	
Frazer Pritchard, Contract 10, for removing and disposing of used machinery and erecting boilers at Chestnut Hill Pumping Station No. 1	2,700 00	
James Driscoll & Son Co., Contract 8, for resurfacing Washington Street near Brookline Avenue, in Brookline	3,470 45	
Worthington Pump & Machinery Corp., Contract 3, for building and erecting pumping engine at Chestnut Hill Pumping Station No. 1	37,950 00	
D. M. Dillon Steam Boiler Works, Contract 5, for furnishing two vertical fire-tube boilers for Chestnut Hill Pumping Station No. 1	18,800 50	
Norfolk Iron Co., Contract 16, for galleries for two boilers at Chestnut Hill Pumping Station No. 1	1,094 80	
Underwood Machinery Co., Contract 9, for coal conveying equipment at Chestnut Hill Pumping Station No. 1	3,942 50	
Harvey L. Maney, Contract 15, for constructing reservoir foundation on Arlington Heights	7,538 65	
George T. Rendle, Contract 11, for laying 12-inch water pipes under the Neponset River, and New York, New Haven & Hartford Railroad, Boston	4,889 89	
Atlantic Works, Contract 14, for 30-inch hydraulic lift valves	2,003 45	
Warren Foundry & Machinery Co., Contract 12, for cast-iron water pipes and special castings	901 00	
Lumsden & Van Stone Co., Contract 13, for flanged special castings	2,060 74	
		91,628 98
Additional work:		
Labor	$16,711 53	
Traveling	2 70	
Freight and express	238 09	
Tools, machinery, appliances and hardware supplies	2,424 12	
Electrical supplies	441 65	
Castings, ironwork and metals	3,184 43	
Iron pipe and valves	1,458 42	
Amounts carried forward	$24,460 94	$107,178 12

General Character of Expenditures.	For the Year ending December 31, 1921.	
Amounts brought forward	$24,460 94	$107,178 12
Construction — Con.		
Additional work — *Con.*		
Paint and coating	23 50	
Lumber and field buildings	637 12	
Brick, cement and stone	1,975 70	
Sand, gravel and filling	221 45	
Unclassified supplies	535 37	
Miscellaneous expenses	63 40	
		27,917 48
Purchase of Existing Water Works.		
Legal and expert:		
Legal services	$595 70	
Expert services	3,200 00	
Court expenses	16,263 00	
Miscellaneous expenses	1,575 09	
		21,633 79
		$156,729 39
Amount charged from beginning of work to January 1, 1921		43,287,875 89
Total amount of construction expenditures to January 1, 1922		43,444,605 28
Maintenance and Operation of Works.		
Administration: —		
Commissioners	$2,575 00	
Secretary and assistants	7,370 50	
Rent	870 00	
Repairs of building	32 90	
Fuel	161 72	
Lighting	93 10	
Care of building	856 68	
Postage	240 00	
Printing, stationery and office supplies	1,278 18	
Telephones	152 91	
Traveling expenses	10 00	
Miscellaneous expenses	92 31	
		13,733 30
General supervision:		
Chief engineer and assistants	$30,624 78	
Rent	2,610 04	
Repairs of building	100 64	
Fuel	485 17	
Lighting	279 13	
Care of building	2,569 14	
Postage	212 50	
Express and telegrams	222 00	
Printing, stationery and office supplies	1,710 21	
Telephones	540 09	
Traveling expenses	740 78	
Miscellaneous expenses	861 26	
		40,955 74
Amount carried forward		$54,689 04

General Character of Expenditures.	For the Year ending December 31, 1921.	
Amount brought forward		$54,689 04
Pumping service:		
Superintendence	$8,623 37	
Labor	121,177 38	
Fuel	77,642 48	
Oil, waste and packing	3,296 90	
Repairs	12,337 82	
Small supplies	2,032 67	
Payments under industrial accident law and special benefit appropriations	520 32	
		225,630 94
Reservoirs, aqueducts, pipe lines, buildings and grounds:		
Superintendents	$9,180 00	
Engineering assistants	20,488 56	
Sanitary inspectors	4,080 00	
Labor, pay roll	310,605 17	
Labor, miscellaneous	2,898 90	
Alterations and repairs of pumping stations	1,131 66	
Alterations and repairs of other buildings and structures	14,574 89	
Automobiles	15,135 79	
Brick	374 04	
Brooms, brushes and janitor's supplies	292 64	
Castings, ironwork and metals	1,411 20	
Cement and lime	1,394 08	
Drafting and photo supplies	520 03	
Electrical supplies	3,480 01	
Fertilizer and planting material	2,704 80	
Freight and express	1,203 71	
Fuel	6,596 91	
Gypsy moth supplies	2,193 89	
Hardware	1,827 21	
Hay and grain	1,402 06	
Horses	225 00	
Lighting	383 28	
Lumber	1,217 78	
Machinery	980 74	
Paints and oils	1,695 45	
Pipe and fittings	3,708 18	
Postage	91 59	
Printing, stationery and office supplies	1,104 48	
Rubber and oiled goods	588 26	
Stable expenses	1,261 88	
Sand, gravel and stone	545 52	
Traveling expenses	3,815 92	
Telephones	1,472 98	
Teaming	1,981 27	
Tools and appliances	6,095 81	
Vehicles, harnesses and fittings	260 69	
Miscellaneous expenses	7,239 63	
Amounts carried forward	$434,164 01	$280,319 98

General Character of Expenditures.	For the Year ending December 31, 1921.	
Amounts brought forward	$434,164 01	$280,319 98
Contracts:		
F. E. Johnson, for work on Fountain Street, Framingham, Mass., at Reservoir No. 2 (authorized by vote of Commission September 1, 1921)	250 00	
Central Building Co., Contract 7-M, for granite facing for circular dam at Quinapoxet River in West Boylston, Mass.	6,812 75	
Whittredge Portable Steel Buildings Co., for furnishing steel garage for Sudbury Reservoir at Fayville, Mass. (authorized by vote of Commission October 27, 1921)	325 00	
Lombard Governor Co., Contract 6-M, for furnishing governors for Wachusett Power Plant at Clinton, Mass.	4,716 00	
Improvement and protection of water supplies	166 23	
Water from city of Worcester	253 00	
Payments under industrial accident law and special benefit appropriations	1,592 67	
		448,279 66
Payments in lieu of taxes		49,103 93
Total expenditures for maintenance and operation		$777,703 57

(*b*) *Receipts.*

The total amount of receipts from the operations of the Commission and from sales of property for the year beginning January 1, 1921, and ending December 31, 1921, was $127,032.98 and the total amount from the time of the organization of the Metropolitan Water Board, July 19, 1895, to December 31, 1921, has been $1,845,406.06. The general character of these receipts is as follows: —

General Character of Receipts.	For the Year ending December 31, 1921.	
Applicable to the loan fund:		
Land and buildings	$3,504 34	
Construction tools, supplies and reimbursements	5,727 88	
		$9,232 22
Applicable to payment of interest, sinking fund requirements and expenses of maintenance and operation:		
Proceeds from operations of the Board:		
Rents	$3,457 10	
Land products	8,025 12	
Electric energy	93,367 95	
Maintenance labor, tools, supplies and reimbursements	4,250 68	
Interest and unclassified receipts	121 28	
		109,222 13
Amount carried forward		$118,454 35

General Character of Receipts.	For the Year ending December 31, 1921.
Amount brought forward	$118,454 35
Applicable to the sinking fund:	
Water supplied to cities and towns, water companies and others	8,578 63
	$127,032 98
Amount credited from beginning of work to January 1, 1921	1,718,373 08
Total receipts to January 1, 1922	$1,845,406 06

The foregoing receipts have been credited to the various objects or works, as follows: —

Sources of Receipts.		For the Year ending December 31, 1921.
Supplying water outside of water district		$8,578 63
Construction and acquisition of works:		
Administration	$117 51	
Sudbury Reservoir	240 00	
Distribution system	5,723 03	
Purchase of existing water works	3,264 34	
		9,344 88
Maintenance and operation of works:		
Administration	$168 48	
General supervision	444 01	
Wachusett Aqueduct	324 49	
Wachusett Reservoir	4,963 49	
Wachusett electric power plant	54,302 74	
Sudbury system	5,565 44	
Sudbury electric power plant	39,065 21	
Distribution system	3,020 28	
Clinton sewerage system	1,255 33	
		109,109 47
		$127,032 98
Amount credited from beginning of work to January 1, 1921		1,718,373 08
Total receipts to January 1, 1922		$1,845,406 06

(*c*) *Assets.*

The following is an abstract of the assets of the water works, a complete schedule of which is kept on file in the office of the Commission: —

Office furniture, fixtures and supplies; engineering and scientific instruments and supplies; police supplies; horses, vehicles, field machinery, etc.; machinery, tools and other appliances and supplies; completed works, real estate and buildings connected therewith.

(d) Liabilities.

There are sundry bills for current expenses which have not yet been received.

Amount on Monthly Estimates, not due until Completion of Contract or until Claims are settled.

Name.	Work.	Amount.
Jos. Hanreddy	Contract 314, Section 7 of the Weston Aqueduct supply mains in Newton.	$10 00
Worthington Pump & Machinery Co.	Contract 3, for building and erecting pumping engine at Chestnut Hill Pumping Station No. 1.	37,950 00
D. M. Dillon Steam Boiler Works	Contract 5, for furnishing two vertical fire-tube boilers for Chestnut Hill Pumping Station No. 1.	989 50
Norfolk Iron Co.	Contract 16, for galleries for two boilers at Chestnut Hill Pumping Station No. 1.	193 20
Underwood Machinery Co.	Contract 9, for coal-conveying equipment at Chestnut Hill Pumping Station No. 1.	142 50
Harvey L. Maney	Contract 15, for constructing reservoir foundation on Arlington Heights.	1,330 35
Geo. T. Rendle	Contract 11, for laying 12-inch water pipes under the Neponset River and New York, New Haven & Hartford Railroad, Boston.	862 92
Atlantic Works	Contract 14, for 30-inch hydraulic lift valves	353 55
Warren Foundry & Machinery Co.	Contract 12, for cast-iron water pipes and special castings.	159 00
Lumsden & Van Stone Co.	Contract 13, for flanged special castings	363 66
Central Building Co.	Contract 7-M, for granite facing for circular dam at Quinapoxet River in West Boylston, Mass.	1,202 25

Settlements are pending with the following parties for land and easements taken in lands owned by them: —

New York, New Haven & Hartford Railroad Company, Frederique Ropp, heirs of Ella Wood, Jack Calcia, Brayton D. Fisher, heirs of Andrew Temple.

SEWERAGE WORKS.

(1) Metropolitan Sewerage Loans, Receipts and Payments.

The loans authorized for the construction of the Metropolitan Sewerage Works, the receipts which are added to the proceeds of these loans, the expenditures for construction, and the balances available on January 1, 1922, have been as follows: —

North Metropolitan System.

Loans authorized under various acts to January 1, 1922, for the construction of the North Metropolitan System and the various extensions $7,512,365 73

Receipts from sales of real estate and from miscellaneous sources which are placed to the credit of the North Metropolitan System:		
For the year ending December 31, 1921	$73 95	
For the period prior to January 1, 1921	87,348 21	
		$87,422 16
		$7,599,787 89
Amount approved for payment from the Metropolitan Sewerage Loan Fund, North System:		
For the year ending December 31, 1921	$25,922 53	
For the period prior to January 1, 1921	7,546,657 58	
		7,572,580 11
Balance, North Metropolitan System, January 1, 1922		$27,207 78

South Metropolitan System.

Loans authorized under the various acts to January 1, 1922, applied to the construction of the Charles River Valley sewer, Neponset valley sewer, high-level sewer and extensions, constituting the South Metropolitan System		$9,912,046 27
Receipts from pumping, sales of real estate and from miscellaneous sources, which are placed to the credit of the South Metropolitan System:		
For the year ending December 31, 1921	$4,756 35	
For the period prior to January 1, 1921	19,881 05	
		24,637 40
		$9,936,683 67
Amount approved for payment from the Metropolitan Sewerage Loan Fund, South System:		
On account of the Charles River valley sewer	$800,046 27	
On account of the Neponset valley sewer	911,531 46	
On account of the high-level sewer and extensions, including Wellesley extension:		
For the year ending December 31, 1921 $98,425 49		
For the period prior to January 1, 1921 8,094,864 72		
	8,193,290 21	
		9,904,867 94
Balance, South Metropolitan System, January 1, 1922		$31,815 73

(2) Total Sewerage Debt, December 31, 1921.

North Metropolitan System.

Bonds issued by the Treasurer of the Commonwealth:		
Sinking fund bonds (3 and 3½ per cent)		$6,563,000 00
Serial bonds (3½ and 4 per cent)		925,500 00
Total bond issue to December 31, 1921		$7,488,500 00
Serial bonds paid prior to January 1, 1921	$154,500 00	
Serial bonds paid in 1921	26,500 00	
		181,000 00
Total bond issue outstanding December 31, 1921		$7,307,500 00
Gross sewerage debt		$7,307,500 00
Sinking fund December 31, 1921		3,534,016 07
Net sewerage debt December 31, 1921		$3,773,483 93

A net decrease for the year of $339,374.72.

South Metropolitan System.

Bonds issued by the Treasurer of the Commonwealth:		
Sinking fund bonds (3 and 3½ per cent)		$8,877,912 00
Serial bonds (4, 4½ and 5 per cent)		945,000 00
Total bond issue to December 31, 1921		$9,822,912 00
Serial bonds paid prior to January 1, 1921	$90,000 00	
Serial bonds paid in 1921	27,000 00	
		117,000 00
Total bond issue outstanding December 31, 1921		$9,705,912 00
Gross sewerage debt		$9,705,912 00
Sinking fund December 31, 1921		2,164,212 31
Net sewerage debt December 31, 1921		$7,541,699 69

A net decrease for the year of $243,829.63.

(3) North and South Metropolitan Loan and Sinking Funds, December 31, 1921.

Year.	Loans.		Bonds issued (Sinking Fund).		Bonds issued (Serial Bonds).		Sinking Fund.
	North System.	South System.	North System.	South System.	North System.	South System.	North and South Systems.
1889	$5,000,000 00	–	–	–	–	–	–
1890	–	–	$2,200,000	$800,000	–	–	–
1891	–	–	368,000	–	–	–	–
1892	–	–	1,053,000	–	–	–	–
1893	–	–	579,000	–	–	–	–
1894	500,000 00	–	500,000	–	–	–	–
1895	300,000 00	$500,000 00	300,000	300,000	–	–	–
1896	30,000 00	–	30,000	200,000	–	–	–
1897	85,000 00	300,000 00	80,000	300,000	–	–	–
1898	215,000 00	35,000 00	220,000	35,000	–	–	–
1899	–	4,625,000 00	–	1,025,000	–	–	$361,416 59
1900	265,000 00	10,912 00[1]	265,000	10,912	–	–	454,520 57
1901	–	40,000 00	–	2,040,000	–	–	545,668 26
1902	–	–	–	864,000	–	–	636,084 04
1903	500,000 00	1,000,000 00	500,000	1,736,000	–	–	754,690 41
1904	–	392,000 00	–	392,000	–	–	878,557 12
1905	–	–	–	–	–	–	1,008,724 95
1906	55,000 00	1,175,000 00	55,000	175,000	–	–	1,146,998 68
1907	–	–	–	300,000	–	–	1,306,850 30
1908	413,000 00	–	–	700,000	–	–	1,492,418 98
1909	–	–	300,000	–	–	–	1,673,784 40
1910	56,000 00	–	113,000	–	–	–	1,931,741 89
1911	6,000 00	–	–	–	–	–	2,184,674 98
1912	378,000 00	–	–	–	$62,000	–	2,458,541 20
1913	–	–	–	–	378,000	–	2,749,337 90
1914	130,500 00	350,000 00	–	–	–	–	3,011,512 44
1915	83,000 00[2]	5,000 00	–	–	130,500	–	3,290,979 46
1916	285,000 00	40,000 00	–	–	70,000	$355,000	3,604,657 27
1917	–	325,000 00	–	–	285,000	40,000	3,925,792 75
1918	–	–	–	–	–	325,000	4,270,205 50
1919	–	225,000 00	–	–	–	–	4,695,573 07
1920	–	100,000 00	–	–	–	225,000	5,168,524 03
1921	–	–	–	–	–	–	5,698,228 38
	$8,301,500 00[3]	$9,122,912 00	–	–	–	–	–
	789,134 27	789,134 27	–	–	–	–	–
	$7,512,365 73	$9,912,046 27	$6,563,000	$8,877,912	$925,500	$945,000	–

[1] The sum of $10,912 was appropriated to reimburse the town of Watertown for the expense of constructing the Watertown siphon.

[2] This amount includes $13,000, balance of appropriation for north metropolitan maintenance under chapter 775, Acts of 1914, which was transferred to North Metropolitan Loan Fund, under authority of chapter 76, Resolves of 1915. No bonds to be issued, as this was cash.

[3] Of this amount, $789,134.27 was expended for the construction of the Charles River valley sewer, which is now included in the South Metropolitan System.

(4) Sewer Assessments, 1921.

The following sewer assessments were made by the Treasurer of the Commonwealth upon the various municipalities:

North Metropolitan Sewerage System.

Sinking fund requirements	$145,759 10
Serial bonds	24,000 00
Interest	235,878 94

Maintenance:		
Appropriated by Legislature	$385,564 77	
Less balance on hand	520 67	
		$384,844 10
Total North Metropolitan sewerage assessment		$790,482 14

South Metropolitan Sewerage System.

Sinking fund requirements		$120,029 44
Serial bonds		27,000 00
Interest		342,257 48
Maintenance:		
Appropriated by Legislature	$204,261 32	
Less balance on hand	354 66	
		203,906 66
Total South Metropolitan sewerage assessment		$693,193 58

In accordance with the provisions of sections 5 and 6, chapter 92 of the General Laws, the proportion to be paid by each city and town to meet the interest and sinking fund requirements for each year is based upon their respective taxable valuations, and to meet the cost of maintenance and operation upon their respective populations.

The divisions of the assessments for 1921 were as follows: —

North Metropolitan Sewerage System.

Cities and Towns.	Assessment.	Cities and Towns.	Assessment.
Arlington	$24,406 13	Reading[1]	$9,934 06
Belmont	15,016 03	Revere	33,234 61
Boston	117,228 57	Somerville	111,731 59
Cambridge	159,936 17	Stoneham	9,027 11
Chelsea	51,050 62	Wakefield	16,642 76
Everett	50,868 58	Winchester	17,620 42
Lexington	6,652 52	Winthrop	19,887 90
Malden	57,181 03	Woburn	20,661 75
Medford	45,955 13		
Melrose	23,447 16	Total	$790,482 14

[1] Reading is also assessed $7,000 for sinking fund requirements in accordance with section 5, chapter 159, General Acts of 1916.

South Metropolitan Sewerage System.

Cities and Towns.	Assessment.	Cities and Towns.	Assessment.
Boston	$346,859 96	Waltham	$38,019 99
Brookline	89,815 63	Watertown	30,704 43
Dedham	14,760 98	Wellesley	14,687 23
Milton	19,331 64		
Newton	80,103 93	Total	$693,193 58
Quincy	58,909 79		

(5) Expenditures for the Different Works.

The following is a summary of the expenditures made in the various operations for the different works: —

Construction and Acquisition of Works.		For the Year ending December 31, 1921.	
North Metropolitan System.			
North System, enlargement:			
Administration		$123 89	
Reading extension:			
Section 75	$15,943 74		
Section 76	7,870 96		
Real estate:			
Legal, conveyancing and expert	350 00		
		24,164 70	
Malden River siphon, Section 19		1,633 94	
			$25,922 53
Amount charged from beginning of work to January 1, 1921			7,546,657 58
Total for North Metropolitan System to January 1, 1922			$7,572,580 11
South Metropolitan System.			
High-level sewer extensions:			
Administration		$108 38	
Wellesley extension:			
Section 99	$22,320 36		
Section 100	33,124 69		
Section 101	42,497 06		
Real estate:			
Legal, conveyancing and expert	375 00		
		98,317 11	
			$98,425 49
Amount charged from beginning of work to January 1, 1921			9,806,442 45
Total for South Metropolitan System to January 1, 1922			$9,904,867 94
Total for construction, both systems			$17,477,448 05

Maintenance and Operation.	For the Year ending December 31, 1921.
North Metropolitan System	$333,983 21
South Metropolitan System	176,938 45
Total for maintenance, both systems	$510,921 66

(6) Detailed Financial Statement.

The Commissioner herewith presents, in accordance with the metropolitan sewerage acts, an abstract of the expenditures and disbursements, receipts, assets and liabilities for the year ending December 31, 1921: —

(a) *Expenditures and Disbursements.*

General Character of Expenditures.	For the Year ending December 31, 1921.	
Construction of Works and Acquisition by Purchase or Taking.		
North System Enlargement.		
Administration:		
Stationery, printing and office supplies	$13 75	
Telephone, lighting, heating, water and care of building	46 07	
Repairs of building	1 57	
Rent and taxes, main office	62 50	
		$123 89
Engineering:		
Engineering assistants	$740 00	
Traveling expenses	51 30	
Stationery, printing and office supplies	8 99	
Telephone, lighting, heating, water and care of building	138 21	
Repairs of building	4 73	
Rent and taxes	187 50	
Miscellaneous expenses	29 62	
		1,160 35
Construction:		
Labor and teaming	$1,303 85	
Brick, cement, lumber and other field supplies and expenses	1,037 18	
		2,341 03
Contracts:		
Bruno & Petitti, Contract 1 (in part), for constructing part of Section 76 of the Reading extension of the North Metropolitan System in Wakefield and Reading	$7,745 86	
Antony Cefalo, Contract 4 (in part), for constructing Section 75 of the Reading extension of the North Metropolitan System in Stoneham and Wakefield	14,201 40	
		21,947 26
Real estate:		
Legal, conveyancing and expert		350 00
Total for North Metropolitan System		$25,922 53
South Metropolitan System.		
High-level Sewer Extensions.		
Administration:		
Stationery, printing and office supplies	$8 96	
Telephone, lighting, heating, water and care of building	45 61	
Amount carried forward	$54 57	

General Character of Expenditures.	For the Year ending December 31, 1921.	
Amount brought forward	$54 57	
High-level Sewer Extension — Con.		
Administration — *Con.*		
Repairs of building	1 31	
Rent and taxes, main office	52 50	
		$108 38
Engineering:		
Engineering assistants	$2,615 00	
Inspectors	2,165 63	
Traveling expenses	96 55	
Stationery, printing and office supplies	1 90	
Engineering and drafting supplies	60	
Telephone, lighting, heating, water and care of building	136 84	
Repairs of building	3 94	
Rent and taxes, main office	157 50	
Miscellaneous expenses	281 74	
		5,459 70
Construction:		
Brick, cement, lumber and other field supplies and expenses		564 76
Contracts:		
Rendle-Stoddard Co., Contract 3, for constructing Section 99 (in part) of the Wellesley extension of the high-level sewer in Dedham	$21,709 84	
Bruno & Petitti, Contract 2, for constructing Section 100 of the Wellesley extension of the high-level sewer in Dedham	31,614 03	
Rendle-Stoddard Co., Contract 145, for constructing Section 101 of the Wellesley extension of the high-level sewer in Needham and Dedham	38,593 78	
		91,917 65
Real estate:		
Legal, conveyancing and expert		375 00
Total for South Metropolitan System		$98,425 49
Maintenance and Operation of Works. *North Metropolitan System.*		
Administration:		
Commissioners	$672 67	
Secretary and assistants	1,959 00	
Rent	225 44	
Heating, lighting and care of building	319 39	
Repairs of building	3 98	
Postage	54 00	
Printing, stationery and office supplies	510 58	
Telephones	38 80	
Traveling expenses	10 00	
Miscellaneous expenses	37 60	
		$3,831 46
Amount carried forward		$3,831 46

General Character of Expenditures.	For the Year ending December 31, 1921.	
Amount brought forward		$3,831 46
North Metropolitan System — Con.		
General supervision:		
Chief engineer and assistants	$10,257 62	
Rent	676 34	
Heating, lighting and care of building	958 23	
Repairs of building	11 94	
Postage	20 00	
Printing, stationery and office supplies	362 93	
Telephones	117 79	
Traveling expenses	65 20	
Miscellaneous expenses	574 10	
		13,044 15
Deer Island pumping station:		
Labor	$33,810 40	
Fuel	28,629 82	
Oil and waste	539 07	
Water	1,831 10	
Packing	199 58	
Repairs and renewals	1,013 41	
General supplies	410 39	
Miscellaneous supplies and expenses	253 04	
		66,686 81
East Boston pumping station:		
Labor	$38,902 35	
Fuel	35,635 05	
Oil and waste	1,239 33	
Water	2,136 42	
Packing	145 04	
Repairs and renewals	2,146 58	
General supplies	1,067 19	
Miscellaneous supplies and expenses	804 49	
		82,076 45
Charlestown pumping station:		
Labor	$24,164 56	
Fuel	14,640 45	
Oil and waste	538 84	
Water	1,176 12	
Packing	76 99	
Repairs and renewals	495 27	
General supplies	170 05	
Miscellaneous supplies and expenses	153 03	
		41,415 31
Alewife Brook pumping station:		
Labor	$12,249 88	
Fuel	4,598 86	
Oil and waste	513 84	
Amounts carried forward	$17,362 58	$207,054 18

General Character of Expenditures.	For the Year ending December 31, 1921.	
Amounts brought forward	$17,362 58	$207,054 18
North Metropolitan System — Con.		
Alewife Brook pumping station — *Con.*		
Water	257 64	
Packing	26 10	
Repairs and renewals	145 70	
General supplies	60 91	
Miscellaneous supplies and expenses	60 56	
		17,913 49
Sewer lines, buildings and grounds:		
Engineering assistants	$2,640 00	
Labor	51,400 82	
Automobiles	419 51	
Brick, cement and lime	473 94	
Castings, ironwork and metals	940 31	
Freight, express and teaming	22 37	
Fuel and lighting	163 65	
Jobbing and repairing	3,348 34	
Lumber	2,224 87	
Machinery, tools and appliances	1,127 34	
Paints and oils	1,094 46	
Rubber and oiled goods	372 50	
Sand, gravel and stone	282 45	
Telephones	299 47	
Traveling expenses	1,405 05	
General supplies	1,918 25	
Miscellaneous expenses	642 82	
		68,776 15
Horses, vehicles and stable account		4,868 54
Payments under industrial accident law and special benefit appropriations		527 29
		$299,139 65
For the completion of Reading extension pumping station (item 635, chapter 203, Acts of 1921):		
Administration	$1,747 41	
Engineering	2,245 00	
Preliminary	64 55	
Contracts:		
Starkweather & Broadhurst, Contract 9, for pumps and motors for Reading extension pumping station — $3,798 00		
Bruno & Petitti, Contract 1 (in part), for constructing part of Section 76 of the Reading extension of the North Metropolitan System in Wakefield and Reading — 5,030 71		
Antony Cefalo, Contract 4 (in part), for constructing Section 75 of the Reading extension of the North Metropolitan System in Stoneham and Wakefield — 5,651 70		
	14,480 41	
Additional	15,600 58	
Real estate, settlements	698 70	
Legal, conveyancing and expert	6 91	
		34,843 56
Total for North Metropolitan System		$333,983 21

General Character of Expenditures.	For the Year ending December 31, 1921.	
South Metropolitan System.		
Administration:		
Commissioners	$852 34	
Secretary and assistants	2,450 50	
Rent	232 05	
Heating, lighting and care of building	362 56	
Repairs of building	3 15	
Postage	46 00	
Printing, stationery and office supplies	393 91	
Telephones	36 78	
Miscellaneous expenses	17 71	
		$4,395 00
General supervision:		
Chief engineer and assistants	$7,110 95	
Rent	696 18	
Heating, lighting and care of building	1,087 77	
Repairs of building	9 45	
Printing, stationery and office supplies	268 37	
Telephones	110 35	
Traveling expenses	50 00	
Miscellaneous expenses	2 00	
		9,335 07
Ward Street pumping station:		
Labor	$37,844 70	
Fuel	24,807 83	
Oil and waste	532 38	
Water	2,006 40	
Packing	420 94	
Repairs and renewals	1,443 16	
General supplies	898 83	
Miscellaneous supplies and expenses	227 31	
		68,181 55
Quincy pumping station:		
Labor	$12,896 29	
Fuel	8,316 18	
Oil and waste	226 94	
Water	367 67	
Packing	57 95	
Repairs and renewals	465 57	
General supplies	339 71	
Miscellaneous supplies and expenses	61 83	
		22,732 14
Nut Island screen-house:		
Labor	$13,300 05	
Fuel	3,636 00	
Oil and waste	229 52	
Water	341 42	
Packing	44 91	
Repairs and renewals	385 59	
General supplies	390 58	
Miscellaneous supplies and expenses	63 18	
		18,391 25
Amount carried forward		$123,035 01

General Character of Expenditures.	For the Year ending December 31, 1921.	
Amount brought forward		$123,035 01
South Metropolitan System — Con.		
Sewer lines, buildings and grounds:		
Engineering assistants	$5,705 00	
Labor	32,801 65	
Automobiles	1,505 53	
Brick, cement and lime	89 35	
Castings, ironwork and metals	202 55	
Fuel and lighting	62 75	
Freight, express and teaming	50	
Jobbing and repairing	426 39	
Lumber	289 19	
Machinery, tools and appliances	275 43	
Paints and oils	319 66	
Rubber and oiled goods	69 43	
Sand, gravel and stone	486 94	
Telephones	233 89	
Traveling expenses	1,102 34	
General supplies	1,015 27	
Miscellaneous expenses	239 47	
		44,825 34
City of Boston for pumping		5,869 36
Horses, vehicles and stable account		2,640 74
Payments under industrial accident law and special benefit appropriations		568 00
Total for South Metropolitan System		$176,938 45

(*b*) *Receipts.*

The receipts from the sales of property, from rents and from other sources, have been credited as follows: —

Account.	For the Year ending December 31, 1921.
Construction:	
North Metropolitan System	$73 95
South Metropolitan System	4,756 35
Maintenance:	
North Metropolitan System	527 01
South Metropolitan System	611 69
Sinking fund:	
North Metropolitan System	75 00
Interest fund:	
North Metropolitan System	29 20
South Metropolitan System	38 46
	$6,111 66
Amount credited from beginning of work to January 1, 1921	156,185 11
Total receipts to January 1, 1922	$162,296 77

(*c*) *Assets.*

The following is an abstract of the assets of the sewerage works, a complete schedule of which is kept on file in the office of the Commission: —

Office furniture, fixtures and supplies; engineering and scientific instruments and supplies; horses, vehicles, field machinery, etc.; machinery, tools and other appliances and supplies; completed works, real estate connected therewith.

(*d*) *Liabilities.*

There are sundry bills for current expenses which have not yet been received.

Amounts on Monthly Estimates, not due until Completion of Contracts or until Claims are settled.

Name.	Work.	Amount.
High-level sewer extensions:		
Timothy O'Connell	Contract 57, Section 82 (in part)	$60 00
Rendle-Stoddard Co.	Contract 3 (new series), Section 99 (in part), Wellesley extension.	1,200 00
Bruno & Petitti	Contract 2 (new series), Section 100, Wellesley extension.	199 72
Rendle-Stoddard Co.	Contract 145, Section 101, Wellesley extension	2,000 00

Settlements are pending with the following parties for easements taken in lands owned by them: —

Clifford M. Locke, Martha W. Burrage, Edward and Catherine Bingham, Hannah Bingham, Katherine H. Rooney, Mary A. Read, Hannah E. Pond, Richard G. Wadsworth, Frank D. Chase, heirs of Stephen M. Weld, Bear Hill Associates, Herbert M. Hopkins, George A. Forbes, Lawrence Minot and Moses Williams, Trustees, Frederick P. Royce and Francis Peabody, Trustees, Maurice McKenna, Michael Flynn, Cornelius J. Sweeney, Mary A. Scalley, Stoneham Branch Railroad, Elizabeth L. McGrady, Margaret McLaughlin, Annie E. Greene, Richard C. Christie, Carl and Emelia Christiansen, Ida A. Nilsson, Bridget Mary McCarty, Walter Steele, Betty K. Farr, Emma C. and Ruth G. Prescott.

APPENDIX

Appendix No. 1.

Contracts made and pending during

[The details of contracts made before

	1. Number of Contract.	2. Work.	3. Number of Bids.	Amount of Bid. 4. Next to Lowest.	Amount of Bid. 5. Lowest.	6. Contractor.
1	1[1]	Furnishing 2 vertical fire tube boilers for Chestnut Hill Pumping Station No. 1.	2	$21,800 00	$19,790 00[2]	D. M. Dillon Steam Boiler Works, Fitchburg, Mass.
2	3	Building and erecting pumping engine for Chestnut Hill Pumping Station No. 1.	2	86,600 00	75,900 00[2]	Worthington Pump & Machinery Corporation, New York.
3	4[1]	Furnishing 35 kilowatt electric lighting unit for Chestnut Hill Pumping Station No. 2.	3	3,960 00	3,649 00[2]	Ames Iron Works, Oswego, N. Y.
4	5[1]	Six street chambers for Venturi meter registers.	3	3,000 00	2,628 00[2]	Hodge Boiler Works, East Boston.
5	7[1]	Purchase and removal of three used 150 h. p. horizontal return tubular boilers at Chestnut Hill pumping station.	2	301 00[3]	500 00[2,4]	Thomas Rush, Boston.
6	8[1]	Resurfacing Washington Street near Brookline Avenue, Brookline.	3	3,637 50	3,605 00[2]	James Driscoll & Son Co., Brookline, Mass.
7	9[1]	Coal-conveying equipment for Chestnut Hill Pumping Station No. 1.	4	5,700 00	4,085 00[2]	Underwood Machinery Co., South Boston.
8	10[1]	Removing and disposing of used machinery and unloading and erecting boilers at Chestnut Hill Pumping Station No. 1.	3	3,000 00	2,700 00[2]	Frazer Pritchard, Watertown, Mass.
9	11[1]	Laying 12-inch water pipes under Neponset River, Boston.	6	6,000 00	5,443 00[2]	George T. Rendle Co., Boston.
10	12[1]	14 tons 30-inch cast-iron water pipe; 5 tons special castings.	2	1,259 70	1,060 00[2]	Warren Foundry & Machine Co., Phillipsburg, N. J.
11	13[1]	17 tons flanged special castings.	5	2,686 00	2,295 00[2]	Lumsden & Van Stone Co., Boston.

[1] Contract completed.

[2] Contract based upon this bid.

Appendix No. 1.

THE YEAR 1921 — WATER DIVISION.

1921 have been given in previous reports.]

7. Date of Contract.	8. Date of Completion of Contract.	9. Prices of Principal Items of Contract.	10. Value of Work done Dec. 31, 1921.	
May 27, 1920	June 3, 1921	See previous report	$19,790 00	1
Oct. 29, 1920	–	See previous report	50,000 00	2
Aug. 25, 1920	Feb. 18, 1921	See previous report	3,649 00	3
Nov. 12, 1920	Feb. 24, 1921	See previous report	2,628 00	4
Dec. 22, 1920	Feb. 24, 1921	See previous report	500 00	5
April 20, 1921	June 23, 1921	For all excavation, $2 per cu. yd.; for constructing concrete base, $12.50 per cu. yd.; for brick paving on sand cushion, $4.05 per sq. yd.	3,470 45	6
May 25, 1921	Aug. 12, 1921	For whole work, $4,085	4,085 00	7
May 3, 1921	June 23, 1921	For whole work, $2,700	2,700 00	8
Sept. 17, 1921	Dec. 1, 1921	For laying 12-inch cast-iron pipe with flexible joints, $14 per lin. ft.; for laying 12-inch cast-iron pipe with ordinary joints, $11.50 per lin. ft.; for laying 4-inch cast-iron pipe for blow-offs, $9 per lin. ft.; for valve chambers, $216 per chamber; for concrete masonry, $30 per cu. yd.	5,752 81	9
Sept. 21, 1921	Dec. 31, 1921	For 30-inch cast-iron pipe, $40 per ton of 2,000 pounds; for special castings, $100 per ton of 2,000 pounds, f. o. b. cars at foundry.	1,209 80	10
Sept. 21, 1921	Dec. 9, 1921	For flanged special castings, $135 per ton of 2,000 pounds, f. o. b. foundry.	2,424 40	11

[3] Next to highest bid.

[4] Highest bid.

CONTRACTS MADE AND PENDING DURING

	1. Number of Contract.	2. Work.	3. Number of Bids.	Amount of Bid. 4. Next to Lowest.	Amount of Bid. 5. Lowest.	6. Contractor.
12	14[1]	2 30-inch hydraulic lift valves	2	$6,950 00	$4,714 00[2]	Atlantic Works, East Boston.
13	15[1]	Reservoir foundation on Arlington Heights.	25	9,395 00	8,790 00[2]	Harvey L. Maney, Cambridge, Mass.
14	16[1]	Galleries for two boilers at Chestnut Hill Pumping Station No. 1.	5	1,488 00	1,288 00[2]	Norfolk Iron Co., Norfolk Downs, Mass.
15	39-M[1]	Sale and purchase of electric energy to be developed at Sudbury Dam in Southborough.	2	–[5]	–[5]	Edison Electric Illuminating Co. of Boston.
16	51-M	Sale and purchase of electric energy to be developed at Wachusett Dam in Clinton.	1	–	$5.30 per M kilowatt hours.	New England Power Co. and Edison Electric Illuminating Co. of Boston.
17	4-M	7,000 net tons bituminous coal for Chestnut Hill, Arlington and Hyde Park pumping stations and for Pegan pumping station.	7	$3.38 net ton at mines to Oct. 1, 1921; $3.88 from Oct. 1, 1921; to March 31, 1922.	$3.75 per net ton at mines.	Wm. A. Jepson Corporation, Boston.
18	5-M	800 to 1,000 net tons bituminous coal and 600 to 700 net tons anthracite screenings for Spot Pond pumping station.	–	–[6]	–[6]	Locke Coal Co., Malden.
19	6-M	Governing equipment for Wachusett power station, Clinton.	–	–[6]	–[6]	Lombard Governor Co., Ashland, Mass.
20	7-M	Granite facing for circular dam on Quinapoxet River, West Boylston.	6	11,478 00	11,450 00	Central Building Co., Worcester, Mass.
21	8-M	Sale of electric energy to be developed at Sudbury Dam in Southborough.	1	–[7]	–[7]	– –

[1] Contract completed.

[2] Contract based upon this bid.

[5] Contract based upon bid of $6.25 per thousand kilowatt hours for entire output. Other bid for portion of output.

THE YEAR 1921 — WATER DIVISION — *Continued.*

7. Date of Contract.	8. Date of Completion of Contract.	9. Prices of Principal Items of Contract.	10. Value of Work done Dec. 31, 1921.	
Sept. 19, 1921	Dec. 31, 1921	For 30-inch hydraulic lift valves, $2,357 per valve .	[6]$4,799 75	12
Oct. 10, 1921	Dec. 30, 1921	For earth excavation, $1.15 per cu. yd.; for rock excavation, $4 per cu. yd.; for concrete masonry Class A, $7.80 per cu. yd.; for concrete masonry Class B, $10 per cu. yd.	10,557 00	13
Oct. 10, 1921	Dec. 8, 1921	For building and erecting at Chestnut Hill Pumping Station No. 1 galleries for two vertical boilers, $1,288.	1,288 00	14
Dec. 21, 1914	Jan. 1, 1922	See previous report	177,540 85	15
Jan. 13, 1917	Jan. 1, 1929	See previous report	141,401 17	16
April 16, 1921	–	For coal furnished on cars at mines, $3.75 per net ton	18,435 31	17
May 4, 1921	–	For bituminous coal delivered in bins at Spot Pond pumping station, $9.25 per net ton for coal delivered previous to Oct. 1, 1921, and $9.65 per net ton for coal delivered after that date; for anthracite screenings delivered previous to April 1, 1922, $5.50 per net ton.	9,792 37	18
Aug. 11, 1921	–	For furnishing open system governing equipment, including 4 Type T governors for the main turbines, a Type F governor for one of the exciter turbines, and a central pumping plant to furnish power for operation of same, $7,860.	6,288 00	19
Sept. 7, 1921	–	For furnishing and placing the granite facing, including all incidental work, $11,450.	10,305 00	20
–	–	– –	–	21

[6] Competitive bids were not received.

[7] Only one bid received, and that rejected. Sale of energy continued at same price as formerly under modified agreement.

CONTRACTS MADE AND PENDING DURING THE YEAR 1921 — WATER DIVISION — *Concluded.*

Summary of Contracts, 1895 to 1921, inclusive.[1]

	Value of Work done Dec. 31, 1921.
Distribution Section, 6 contracts	$28,417 81
Pumping Service, 7 contracts	83,936 40
	$112,354 21
403 contracts completed from 1896 to 1920, inclusive	17,653,669 79
	$17,766,024 00
Deduct for work done on 11 Sudbury Reservoir contracts by the city of Boston	512,000 00
Total of 416 contracts	$17,254,024 00

[1] In this summary contracts for the sale of used material and contracts charged to maintenance are excluded.

Appendix No. 2.

Table No. 1. — *Monthly Rainfall in Inches at Various Places on the Metropolitan Water Works, 1921.*

	Place.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
Wachusett Watershed.	Princeton	2.84	4.17	2.58	7.17	2.92	4.70	6.26	2.05	3.21	2.32	6.27	2.82	47.31
	Jefferson	2.56	4.38	3.29	7.20	3.94	4.02	5.39	2.17	2.37	2.20	6.97	3.19	47.68
	Sterling	2.67	3.93	2.68	6.55	2.64	3.34	6.15	1.43	2.15	1.75	7.32	2.50	43.11
	Boylston	2.62	3.81	2.92	5.13	2.52	2.95	7.84	2.11	1.68	1.72	8.68	2.55	44.53
Sudbury Watershed.	Sudbury Dam	2.64	4.16	2.67	5.22	3.28	4.23	6.02	1.00	1.85	1.14	8.06	2.49	42.76
	Framingham	2.80	4.28	2.55	5.42	3.66	3.95	6.72	1.19	2.08	1.07	7.85	2.47	44.04
	Ashland Dam	2.90	3.95	2.78	5.23	2.70	3.38	6.14	1.32	1.83	1.04	7.53	2.50	41.30
	Cordaville	2.78	4.02	2.89	5.32	3.27	3.72	8.56	1.29	1.74	1.23	8.37	2.71	45.90
Lake Cochituate		2.75	3.58	2.87	5.85	3.31	4.13	7.92	1.27	2.24	1.13	7.75	2.51	45.31
Chestnut Hill Reservoir		2.78	3.81	2.74	6.50	2.41	4.67	8.86	1.48	1.73	1.09	6.72	2.65	45.44
Spot Pond		2.47	3.96	2.87	5.36	2.11	4.14	9.07	1.27	2.70	1.15	6.86	2.72	44.68
Average of all		2.71	4.01	2.80	5.90	2.98	3.93	7.17	1.51	2.14	1.44	7.49	2.65	44.73
Average, Wachusett watershed		2.67	4.07	2.87	6.51	3.01	3.75	6.41	1.94	2.35	2.00	7.31	2.77	45.66
Average, Sudbury watershed		2.78	4.10	2.72	5.30	3.23	3.82	6.86	1.20	1.88	1.12	7.95	2.54	43.50

TABLE NO. 2. — *Rainfall in Inches at Jefferson, Mass., in 1921.*

DAY OF MONTH.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1	[3]	–	–	–	0.20	–	[3]	–	–	–	[3]	–
2	0.17	–	–	–	–	–	1.74	–	–	–	[3]	0.82
3	–	[3]	0.12	–	–	–	–	–	–	0.54	0.52	–
4	–	[3]	–	–	[3]	–	–	–	–	–	–	–
5	0.46	0.19[2]	0.14	–	[3]	–	–	–	–	–	–	–
6	–	–	[3]	–	0.05	–	–	–	–	–	–	–
7	0.29[2]	[3]	[3]	[3]	–	–	–	[3]	0.05	–	0.13[1]	–
8	–	0.09[1]	[3]	[3]	–	–	–	0.95	–	0.28	–	–
9	–	0.09[2]	0.86	0.64	–	–	0.99	–	–	–	[3]	–
10	–	[3]	–	[3]	–	–	–	–	0.14	–	0.79	–
11	–	1.11[1]	–	0.01[1]	–	–	–	–	[3]	–	–	–
12	–	–	0.55	–	–	–	–	–	0.12	0.37	–	0.22
13	–	–	–	–	1.43	0.07	–	–	–	–	–	–
14	1.01[2]	–	–	–	0.03	–	–	0.15	–	–	[3]	–
15	–	–	0.03	0.74	–	–	0.30	–	–	–	0.57[2]	–
16	–	–	0.05	0.23	0.01	–	–	–	–	–	–	–
17	–	–	–	[3]	–	–	–	[3]	0.20	–	[3]	[3]
18	–	–	–	0.93[2]	–	0.08	–	1.07	–	–	0.87	0.82
19	–	–	[3]	–	–	–	0.50	–	–	0.24	–	–
20	–	2.20[1]	0.11	–	–	–	–	–	–	0.77	0.59	–
21	–	–	–	–	–	–	0.06	–	[3]	–	0.17	0.05[1]
22	–	–	–	[3]	–	–	–	–	1.20	–	–	–
23	0.05	0.01	–	[3]	0.50	–	–	–	–	–	[3]	[3]
24	–	–	[3]	1.25	–	–	–	–	–	–	0.41	[3]
25	–	–	0.65	–	0.26	–	–	–	0.26	–	–	0.58[2]
26	–	–	0.15	–	–	0.12	–	–	–	–	[3]	–
27	–	[3]	–	–	–	0.02	–	–	–	–	[3]	–
28	–	0.69	–	–	–	[3]	0.13	–	–	–	[3]	–
29	–	–	–	[3]	1.46	[3]	0.85	–	–	–	2.92[2]	0.70[1]
30	[3]	–	–	[3]	–	[3]	0.71	–	0.40	–	–	–
31	0.58[2]	–	0.63	3.40	–	3.73	0.11	–	–	–	–	–
Totals	2.56	4.38	3.29	7.20	3.94	4.02	5.39	2.17	2.37	2.20	6.97	3.19

Total for the year, 47.68 inches.

[1] Snow. [2] Rain and snow. [3] Rainfall included in that following.

TABLE No. 3. — *Rainfall in Inches at Framingham, Mass., in 1921.*

DAY OF MONTH.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1	[3]	–	–	0.05	0.49	–	[3]	–	–	–	0.33	–
2	0.04	–	[3]	–	–	–	1.58	–	–	–	–	0.55
3	–	–	0.09	–	–	[3]	–	–	–	0.32	0.02	–
4	–	–	–	–	–	0.03	–	–	–	–	0.02	–
5	[3]	0.23	0.07	–	[3]	–	–	–	–	–	–	–
6	0.72[2]	–	[3]	–	0.01	–	–	–	[3]	–	–	–
7	[3]	[3]	[3]	[3]	–	–	–	0.15	0.13	–	0.08	–
8	0.31[2]	0.13[1]	[3]	[3]	–	–	–	0.18	–	0.07	–	–
9	–	0.07[2]	0.48	0.49	–	–	1.10	–	–	–	[3]	–
10	–	[3]	–	–	–	–	0.66	–	0.33	–	1.16[2]	–
11	–	0.80[1]	–	0.04[1]	–	0.05	–	[3]	[3]	–	–	–
12	–	–	0.60	–	[3]	–	–	0.03	0.20	0.07	0.02	[3]
13	–	–	–	–	1.06	0.02	–	0.01	–	–	–	0.45[2]
14	1.13[2]	0.03[2]	[3]	–	0.16	–	–	0.14	–	–	0.47[2]	–
15	–	–	0.05	[3]	–	0.05	0.44	–	0.03	–	–	–
16	–	–	0.01	0.29	0.02	–	–	–	–	–	[3]	0.03[1]
17	–	–	0.01	[3]	–	–	–	[3]	0.05	–	[3]	[3]
18	–	–	–	[3]	–	0.27	–	0.68	–	–	0.87	0.70
19	–	–	0.06	0.69[2]	–	–	[3]	–	–	0.11	0.02	–
20	–	2.33[1]	–	–	–	–	0.63	–	–	0.35	0.41	–
21	–	–	–	–	–	–	0.61	–	1.01	–	0.25	0.04
22	0.03	–	–	0.02	–	–	–	–	–	–	–	–
23	–	0.02	–	[3]	0.53	–	–	–	–	–	[3]	[3]
24	–	–	[3]	0.90	–	–	–	–	–	[3]	0.45[2]	[3]
25	–	–	0.52	–	0.28	–	–	–	0.03	0.10	–	0.70[2]
26	–	–	0.02	–	–	0.47	–	–	–	–	[3]	–
27	–	[3]	–	0.01	–	–	–	–	–	–	[3]	–
28	–	0.67	0.07	0.02	–	[3]	0.10	–	–	–	[3]	–
29	–	–	–	–	1.06	[3]	1.03	–	–	–	3.75[2]	–
30	[3]	–	–	–	0.05	[3]	0.04	–	0.30	–	–	–
31	0.57[2]	–	0.57	2.91	–	3.06	0.53	–	–	0.05	–	–
Totals	2.80	4.28	2.55	5.42	3.66	3.95	6.72	1.19	2.08	1.07	7.85	2.47

Total for the year, 44.04 inches.

[1] Snow. [2] Rain and snow. [3] Rainfall included in that following.

TABLE NO. 4. — *Rainfall in Inches at Chestnut Hill Reservoir, 1921.*

DATE.	Amount.	Duration.	DATE.	Amount.	Duration.
Jan. 1	.07	7.15 P.M. to 12.15 P.M.	May 1	.31	7.30 A.M. to 11.30 A.M.
Jan. 2			May 5	.03	7.00 P.M. to 9.45 P.M.
Jan. 5	.50	3.00 P.M. to	May 13	1.23	5.15 A.M. to
Jan. 6		1.00 P.M.	May 14		1.45 P.M.
Jan. 7	.30[2]	6.45 P.M. to	May 23	.41	5.30 A.M. to 11.30 A.M.
Jan. 8		6.30 A.M.	May 25	.33	11.30 A.M. to
Jan. 14	1.25[2]	7.00 A.M. to	May 26		6.00 A.M.
Jan. 15		3.15 A.M.	May 29	.10	4.00 A.M. to
Jan. 21	.03	3.30 P.M. to 7.45 P.M.	May 30		2.00 A.M.
Jan. 23	.02	3.45 A.M. to 4.45 A.M.			
Jan. 30	.32	9.15 A.M. to 9.10 P.M.	Total	2.41	
Jan. 30	.29[1]	9.10 P.M. to			
Jan. 31		10.00 A.M.			
Total	2.78				
Feb. 5	.21	5.30 P.M. to	June 3	.06	9.25 P.M. to
Feb. 6		4.30 A.M.	June 4		4.30 A.M.
Feb. 7	.16[1]	6.10 P.M. to	June 11	.10	7.20 P.M. to
Feb. 8		2.20 A.M.	June 12		3.30 A.M.
Feb. 9	.48[1]	9.30 P.M. to	June 13	.04	9.00 A.M. to 10.00 A.M.
Feb. 10		2.15 A.M.	June 15	.02	2.00 P.M. to 3.00 P.M.
Feb. 11	.45[1]	12.20 A.M. to	June 18	.23	5.40 P.M. to 9.00 P.M.
Feb. 12		2.15 A.M.	June 26	.09	9.00 A.M. to 11.30 P.M.
Feb. 14	.04[1]	5.00 A.M. to 10.30 A.M.	June 28	.05	11.30 P.M. to
Feb. 20	1.75[1]	5.15 A.M. to 11.50 P.M.	June 29		3.30 A.M.
Feb. 23	.06	3.00 A.M. to 3.30 P.M.	June 29	4.08	5.00 P.M. to
Feb. 27	.66	8.00 P.M. to	July 1		7.30 A.M.
Feb. 28		11.45 A.M.			
Total	3.81		Total	4.67	
Mar. 2	.20	8.20 P.M. to	July 1	.97	7.30 A.M. to
Mar. 3		3.00 P.M.	July 2		6.00 P.M.
Mar. 5	.14	7.50 P.M. to	July 9	2.52	2.30 A.M. to 7.00 A.M.
Mar. 7		6.30 A.M.	July 9	2.14	9.00 A.M. to
Mar. 8	.52	6.45 A.M. to	July 10		4.45 A.M.
Mar. 10		12.30 A.M.	July 15	.28	10.30 A.M. to 7.00 P.M.
Mar. 12	.49	10.40 P.M. to	July 19	.30	11.00 P.M. to
Mar. 13		4.30 A.M.	July 20		4.30 A.M.
Mar. 15	.10	2.15 A.M. to	July 20	.97	6.30 P.M. to
Mar. 16		7.30 A.M.	July 21		1.30 P.M.
Mar. 17	.03	9.00 P.M. to 10.00 P.M.	July 28	.04	7.05 P.M. to
Mar. 20	.08	12.15 A.M. to 5.30 A.M.	July 29		1.15 A.M.
Mar. 25	.58	12.45 A.M. to 8.00 A.M.	July 29	1.52	4.45 P.M. to
Mar. 26	.06	1.20 P.M. to 7.10 P.M.	July 30		1.30 A.M.
Mar. 28	.05	7.35 P.M. to 11.00 P.M.	July 31	.12	5.00 P.M. to 6.15 P.M.
Mar. 31	.49	9.40 P.M. to			
Apr. 1		7.30 A.M.	Total	8.86	
Total	2.74				
Apr. 1	.05	7.03 A.M. to 10.30 A.M.	Aug. 7	.05	11.45 A.M. to 12.30 P.M.
Apr. 7	.94	6.03 P.M. to	Aug. 8	.15	12.40 A.M. to 8.00 A.M.
Apr. 9		5.10 P.M.	Aug. 12	.02	6.00 A.M. to 7.15 A.M.
Apr. 15	.34	1.15 P.M. to 10.30 P.M.	Aug. 12	.03	9.30 A.M. to 10.45 A.M.
Apr. 16	.81	9.00 P.M. to	Aug. 12	.07	9.20 P.M. to 9.40 P.M.
Apr. 19		5.30 A.M.	Aug. 14	.36	11.15 A.M. to 12.30 P.M.
Apr. 22	.04	9.30 A.M. to 10.30 P.M.	Aug. 18	.48	12.30 A.M. to 9.00 A.M.
Apr. 23	1.08	8.00 A.M. to	Aug. 18	.32	4.40 P.M. to 5.15 P.M.
Apr. 24		4.10 P.M.			
Apr. 27	.05	8.30 A.M. to	Total	1.48	
Apr. 28		9.30 A.M.			
Apr. 29	3.19	6.40 P.M. to			
May 1		7.30 A.M.			
Total	6.50				

[1] Snow. [2] Rain or snow.

TABLE No. 4. — *Rainfall in Inches at Chestnut Hill Reservoir, 1921* — Concluded.

DATE.	Amount.	Duration.
Sept. 6	.38	5.20 P.M. to 10.00 A.M.
Sept. 7		
Sept. 10	.05	7.00 P.M. to 8.30 P.M.
Sept. 11	.30	5.25 P.M. to 11.00 A.M.
Sept. 12		
Sept. 15	.04	5.20 P.M. to 5.45 P.M.
Sept. 17	.07	2.00 P.M. to 6.15 A.M.
Sept. 18		
Sept. 21	.60	4.05 P.M. to 5.20 A.M.
Sept. 22		
Sept. 25	.07	7.30 P.M. to 9.00 P.M.
Sept. 30	.22	5.30 P.M. to 8.15 P.M.
Total	1.73	
Oct. 3	.52	1.50 P.M. to 10.30 P.M.
Oct. 8	.07	4.00 P.M. to 5.00 P.M.
Oct. 12	.04	10.30 A.M. to 11.45 A.M.
Oct. 19	.06	3.40 A.M. to 5.50 A.M.
Oct. 20	.32	4.50 A.M. to 1.30 P.M.
Oct. 24	.08	10.45 P.M. to 6.45 A.M.
Oct. 25		
Total	1.09	
Nov. 1	.27	5.00 A.M. to 9.30 P.M.
Nov. 2		
Nov. 3	.04	5.15 P.M. to 11.00 P.M.
Nov. 4	.04	9.40 P.M. to 12.30 A.M.
Nov. 5		
Nov. 7	.09	6.40 A.M. to 10.00 A.M.
Nov. 9	1.31	7.45 A.M. to 12.30 P.M.
Nov. 10		
Nov. 14	.48	6.20 A.M. to 3.30 A.M.
Nov. 15		
Nov. 17	.81	12.25 A.M. to 5.30 A.M.
Nov. 19		
Nov. 20	.26	3.05 A.M. to 11.30 A.M.
Nov. 21	.07	4.10 A.M. to 12.00 M.
Nov. 23	.10[2]	9.30 P.M. to 6.00 A.M.
Nov. 24		
Nov. 24	.28	6.00 A.M. to 7.10 P.M.
Nov. 26	2.97	2.20 P.M. to 6.00 P.M.
Nov. 29		
Total	6.72	
Dec. 2	.62	10.30 P.M. to 2.45 A.M.
Dec. 3		
Dec. 12	.40[2]	8.10 P.M. to 3.00 A.M.
Dec. 13		
Dec. 13	.04[1]	4.25 P.M. to 8.00 P.M.
Dec. 16	.05[1]	9.40 P.M. to 3.45 A.M.
Dec. 17		
Dec. 18	.47	12.30 A.M. to 11.00 A.M.
Dec. 21	.06[1]	5.30 A.M. to 9.30 A.M.
Dec. 23	.41[2]	7.15 A.M. to 3.30 P.M.
Dec. 24	.60[2]	1.45 A.M. to 2.30 A.M.
Dec. 26		
Total	2.65	

Total for year, 45.44 inches.

[1] Snow. [2] Rain and snow.

TABLE NO. 5. — *Rainfall in Inches on the Wachusett Watershed,*[1] *1897 to 1921.*

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1897	3.46	2.86	4.01	2.32	5.06	5.11	8.65	3.47	1.93	0.94	7.62	6.41	51.84
1898	6.65	3.30	2.27	4.43	3.38	3.11	3.01	10.61	3.15	7.21	6.81	3.99	57.92
1899	2.93	5.12	6.75	1.94	1.33	5.51	3.82	3.20	4.11	2.72	1.94	2.03	41.40
1900	4.56	8.69	6.19	2.76	4.34	3.59	3.20	3.18	3.46	2.90	6.44	3.15	52.46
1901	1.75	1.13	5.82	9.64	7.02	1.51	5.66	4.58	3.10	3.70	2.43	9.36	55.70
1902	2.72	4.91	5.27	4.36	2.24	2.51	3.87	3.95	4.26	6.36	0.93	7.20	48.58
1903	2.85	4.42	6.58	3.10	1.24	10.37	3.43	3.88	2.93	4.43	2.36	3.99	49.58
1904	4.02	2.66	3.40	7.45	2.99	3.44	3.84	3.68	5.30	1.78	1.62	2.88	43.06
1905	6.10	1.72	3.95	2.60	0.83	4.88	5.39	3.09	6.90	1.81	2.52	3.79	43.58
1906	2.59	2.74	5.17	3.12	6.58	5.95	5.52	4.34	2.61	3.95	2.25	4.26	49.08
1907	2.84	2.32	1.82	2.65	2.96	3.54	3.03	1.26	9.50	5.68	5.74	4.40	45.74
1908	3.40	4.82	2.77	2.62	5.34	1.29	3.85	6.49	1.04	2.13	1.05	3.03	37.83
1909	3.52	6.10	4.38	5.71	2.65	3.03	4.25	3.59	3.90	1.70	1.68	3.99	44.50
1910	5.86	5.24	1.09	3.01	2.13	4.36	1.52	3.87	2.86	1.40	4.17	2.34	37.85
1911	2.91	2.43	3.79	2.22	1.59	2.37	2.53	5.46	3.04	5.24	4.14	3.01	38.73
1912	2.57	2.42	5.69	4.06	5.76	0.48	2.65	2.89	2.17	2.53	4.02	4.95	40.19
1913	3.38	2.55	5.58	3.90	3.71	0.90	2.37	3.05	4.44	6.02	2.59	2.73	41.22
1914	3.40	3.58	4.33	4.91	3.01	2.00	3.92	4.50	0.15	1.88	2.97	3.89	38.54
1915	6.31	3.32	0.06	1.80	1.67	3.18	8.60	6.90	1.53	3.05	3.12	5.11	44.65
1916	1.60	5.98	3.32	3.65	3.34	6.57	5.66	1.72	4.21	1.42	3.15	2.81	43.43
1917	3.37	3.05	4.21	1.80	3.89	4.47	1.22	4.46	1.20	6.03	1.25	2.31	37.26
1918	2.97	4.25	2.24	3.47	1.07	4.57	2.80	2.82	7.18	1.58	3.08	3.74	39.77
1919	3.23	3.51	5.27	2.57	6.06	2.01	5.00	4.17	6.78	2.35	6.01	2.09	49.05
1920	3.17	6.26	4.26	6.13	4.01	6.07	4.33	2.91	6.39	0.63	5.49	6.01	55.66
1921	2.67	4.07	2.87	6.51	3.01	3.75	6.41	1.94	2.35	2.00	7.31	2.77	45.66
Totals	88.83	97.45	101.09	96.73	85.21	94.57	104.53	100.01	94.49	79.44	90.69	100.24	1,133.28
Average (25 years)	3.55	3.90	4.04	3.87	3.41	3.78	4.18	4.00	3.78	3.18	3.63	4.01	45.33

[1] Means of observations at four places, as follows: January, 1897, to December, 1900, Princeton, Jefferson, Sterling and South Clinton; January, 1901, to December, 1916, Princeton, Jefferson, Sterling and Boylston.

TABLE NO. 6. — *Rainfall in Inches on the Sudbury Watershed,*[1] *1875–1921.*

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1875	2.42	3.15	3.74	3.23	3.56	6.24	3.57	5.53	3.43	4.85	4.83	0.94	45.49
1876	1.83	4.21	7.43	4.20	2.76	2.04	9.13	1.72	4.62	2.24	5.76	3.62	49.56
1877	3.22	0.74	8.36	3.43	3.70	2.43	2.95	3.68	0.32	8.52	5.80	0.87	44.02
1878	5.63	5.97	4.69	5.79	0.96	3.88	2.97	6.94	1.29	6.42	7.02	6.37	57.93
1879	2.48	3.56	5.14	4.72	1.58	3.79	3.93	6.51	1.88	0.81	2.68	4.34	41.42
1880	3.57	3.98	3.31	3.11	1.84	2.14	6.27	4.01	1.60	3.74	1.78	2.83	38.18
1881	5.56	4.65	5.73	2.00	3.51	5.39	2.35	1.36	2.62	2.95	4.09	3.96	44.17
1882	5.95	4.55	2.65	1.82	5.07	1.66	1.77	1.67	8.74	2.07	1.15	2.30	39.40
1883	2.81	3.87	1.78	1.84	4.19	2.40	2.68	0.73	1.52	5.60	1.81	3.55	32.78
1884	5.09	6.54	4.72	4.41	3.47	3.44	3.67	4.65	0.85	2.48	2.65	5.17	47.14
1885	4.71	3.87	1.07	3.60	3.48	2.87	1.43	7.18	1.43	5.09	6.09	2.72	43.54
1886	6.36	6.28	3.61	2.22	3.00	1.47	3.27	4.10	2.90	3.24	4.64	4.97	46.06
1887	5.20	4.78	4.90	4.27	1.16	2.65	3.76	5.28	1.32	2.83	2.67	3.88	42.70
1888	4.15	3.68	6.02	2.43	4.82	2.54	1.41	6.22	8.59	4.99	7.22	5.40	57.47
1889	5.37	1.65	2.37	3.41	2.95	2.80	8.94	4.18	4.60	4.25	6.29	3.14	49.95
1890	2.53	3.51	7.73	2.64	5.21	2.03	2.46	3.87	6.00	10.51	1.20	5.31	53.00
1891	7.02	5.23	6.48	3.91	2.01	3.77	3.39	4.73	2.38	3.83	3.09	3.68	49.52
1892	5.85	3.14	4.06	0.83	5.58	2.76	4.23	4.44	2.84	1.17	5.80	1.13	41.83
1893	2.92	8.20	3.67	3.60	6.61	2.38	2.57	5.41	1.74	4.07	2.20	4.86	48.23
1894	4.09	3.91	1.43	3.42	4.24	1.15	3.26	2.03	2.63	5.34	3.43	4.81	39.74
1895	4.06	1.39	2.98	5.25	2.02	2.77	5.04	4.15	2.30	10.68	6.63	3.35	50.62
1896	2.39	7.18	5.24	1.57	2.57	3.22	2.51	2.40	7.72	3.76	3.02	2.12	43.70
1897	4.00	2.91	3.66	2.82	4.37	4.46	5.44	3.51	2.94	0.47	6.40	5.21	46.19
1898	6.83	4.49	2.40	4.66	3.22	2.48	4.09	8.17	2.62	6.71	6.93	3.28	55.88
1899	4.18	4.91	7.01	1.90	1.45	2.51	3.22	1.43	3.95	2.69	2.18	1.78	37.21
1900	4.96	9.14	6.35	2.58	4.32	2.99	2.42	2.26	3.36	3.83	5.70	2.74	50.65

[1] See note at end of this table.

TABLE No. 6. — *Rainfall in Inches on the Sudbury Watershed,*[1] *1875–1921* — Concluded.

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1901	1.82	1.52	6.57	8.60	7.23	1.38	5.71	4.57	3.30	2.82	2.90	9.69	56.11
1902	2.52	6.18	5.34	4.13	1.86	2.89	2.94	3.40	4.54	4.44	1.45	6.38	46.07
1903	3.80	3.95	6.63	2.99	0.93	9.25	2.77	3.67	1.75	4.72	1.56	3.14	45.16
1904	4.87	3.00	2.72	8.87	2.65	2.80	1.96	3.86	5.80	1.64	1.73	2.92	42.82
1905	5.26	2.20	3.15	2.72	1.31	5.00	5.47	2.70	6.88	1.54	2.07	4.01	42 31
1906	2.47	2.92	6.32	2.88	5.66	3.91	3.42	3.02	3.30	3.40	2.69	4.49	44.48
1907	3.28	2.17	1.91	3.41	3.63	3.53	1.86	1.07	8.76	4.17	6.12	4.47	44.38
1908	3.60	4.56	3.82	1.88	5.51	0.86	3.71	4.57	0.97	2.55	0.98	3.14	36.15
1909	3.98	5.79	4.26	4.67	2.43	2.81	1.59	2.93	4.74	1.12	3.38	4.05	41.75
1910	5.39	5.06	0.85	2.75	1.29	4.68	2.03	2.62	2.49	1.86	4.13	2.49	35.64
1911	2.88	2.77	3.59	2.81	1.01	2.53	3.19	4.94	2.75	3.69	4.62	3.60	38.38
1912	2.94	2.77	6.46	4.37	4.55	0.46	3.24	3.05	1.76	2.35	3.64	5.13	40.72
1913	3.17	2.82	5.75	4.25	3.97	1.98	3.60	3.64	3.77	5.53	2.65	3.18	44.31
1914	3.85	4.07	4.57	5.10	3.08	1.90	3.44	3.82	0.29	1.60	2.53	3.46	37.71
1915	6.51	3.58	0.05	2.48	1.74	3.65	8.12	5.87	1.10	2.95	2.79	5.09	43.93
1916	1.53	5.91	4.16	4.19	3.43	4.77	5.17	2.01	1.80	1.49	2.28	3.22	39.96
1917	3.50	2.68	4.96	2.41	4.93	4.23	1.11	6.40	1.52	5.65	1.31	2.81	41.51
1918	3.47	3.58	2.50	4.43	1.16	3.65	4.07	1.61	8.60	1.04	2.75	3.68	40.54
1919	3.52	3.40	4.79	2.93	4.60	1.86	5.47	3.75	5.28	2.16	5.90	1.98	45.64
1920	3.26	6.49	4.45	5.19	3.45	6.67	2.04	1.78	3.53	1.01	5.68	5.11	48.66
1921	2.78	4.10	2.72	5.30	3.23	3.82	6.86	1.20	1.88	1.12	7.95	2.54	43.50
Totals	187.58	195.01	202.10	170.02	155.30	148.89	174.50	176.64	159.00	169.99	180.17	176.91	2,096.11
Average (47 years)	3.99	4.15	4.30	3.62	3.30	3.17	3.71	3.76	3.38	3.62	3.83	3.77	44.60

[1] Means of observations at several places, as follows: January, 1875, to March, 1876, inclusive, Lake Cochituate; April and May, 1876, Lake Cochituate, Westborough and Hopkinton; June to November, 1876, inclusive, Lake Cochituate, Southborough, Marlborough, Westborough and Hopkinton; December, 1876, to December, 1882, inclusive, Framingham, Southborough, Marlborough, Westborough and Hopkinton; January, 1883, to December, 1889, inclusive, Framingham and Westborough; January, 1890, to May, 1898, inclusive, Framingham and Ashland Dam; since June, 1898, Framingham, Ashland Dam, Cordaville and Sudbury Dam.

TABLE No. 7. — *Yield of the Wachusett Watershed in Gallons per Day per Square Mile,*[1] *1897–1921.*

MONTH.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.
January	796,000	1,563,000	2,092,000	796,000	519,000	1,676,000	1,265,000	659,000	1,266,000	1,132,000	1,458,000	1,738,000	592,000
February	931,000	1,635,000	1,090,000	4,054,000	356,000	1,401,000	2,133,000	927,000	452,000	1,027,000	692,000	1,736,000	2,556,000
March	2,760,000	3,088,000	2,776,000	3,722,000	2,718,000	3,992,000	3,423,000	3,008,000	3,004,000	1,860,000	1,697,000	2,192,000	2,129,000
April	1,632,000	2,027,000	3,376,000	1,580,000	4,986,000	2,159,000	2,238,000	2,984,000	1,617,000	2,109,000	1,436,000	1,269,000	2,422,000
May	1,163,000	1,390,000	862,000	1,382,000	2,729,000	1,031,000	569,000	1,498,000	445,000	1,533,000	965,000	1,415,000	1,212,000
June	1,181,000	828,000	561,000	578,000	985,000	410,000	2,131,000	762,000	542,000	1,184,000	773,000	403,000	632,000
July	1,442,000	333,000	354,000	217,000	477,000	292,000	624,000	497,000	365,000	728,000	335,000	220,000	233,000
August	896,000	1,325,000	236,000	197,000	512,000	297,000	474,000	355,000	321,000	591,000	87,000	443,000	193,000
September	380,000	676,000	250,000	127,000	320,000	241,000	375,000	494,000	1,228,000	277,000	810,000	88,000	208,000
October	243,000	1,509,000	245,000	282,000	647,000	950,000	689,000	347,000	367,000	530,000	1,382,000	158,000	90,000
November	1,283,000	2,170,000	430,000	875,000	517,000	635,000	634,000	343,000	442,000	749,000	2,540,000	125,000	363,000
December	2,275,000	2,061,000	359,000	1,570,000	3,234,000	1,848,000	954,000	440,000	1,018,000	794,000	1,961,000	387,000	537,000
Average	1,253,000	1,551,000	1,051,000	1,264,000	1,507,000	1,248,000	1,285,000	1,025,000	926,000	1,043,000	1,180,000	847,000	918,000
Average, driest six months	886,000	1,013,000	312,000	377,000	576,000	471,000	626,000	413,000	541,000	613,000	725,000	238,000	270,000

[1] See note at end of this table.

TABLE NO. 7. — *Yield of the Wachusett Watershed in Gallons per Day per Square Mile,*[1] *1897–1921* — Concluded.

MONTH.	1910.	1911.	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1920.	1921.	Mean for 25 Years, 1897–1921.
January	1,846,000	773,000	780,000	1,414,000	990,000	2,062,000	1,315,000	686,000	484,000	1,341,000	646,000	1,413,000	1,172,000
February	1,845,000	625,000	927,000	867,000	1,181,000	1,961,000	1,816,000	916,000	2,024,000	794,000	725,000	1,067,000	1,348,000
March	2,640,000	1,339,000	2,831,000	2,263,000	3,137,000	572,000	1,891,000	2,472,000	2,590,000	3,155,000	4,685,000	2,510,000	2,658,000
April	1,034,000	1,393,000	2,281,000	2,083,000	2,593,000	926,000	3,300,000	1,468,000	1,608,000	1,711,000	3,498,000	1,931,000	2,146,000
May	608,000	461,000	1,797,000	1,038,000	1,699,000	455,000	1,697,000	1,317,000	673,000	2,204,000	2,071,000	2,071,000	1,292,000
June	824,000	351,000	331,000	280,000	317,000	228,000	2,054,000	1,229,000	523,000	462,000	1,922,000	480,000	799,000
July	62,000	57,000	135,000	19,000	329,000	1,083,000	1,086,000	264,000	280,000	400,000	809,000	1,021,000	467,000
August	186,000	188,000	125,000	60,000	261,000	1,657,000	284,000	309,000	159,000	262,000	327,000	246,000	400,000
September	145,000	181,000	89,000	219,000	—12,000	158,000	294,000	84,000	603,000	1,093,000	540,000	114,000	359,000
October	68,000	718,000	145,000	678,000	136,000	387,000	140,000	555,000	341,000	495,000	409,000	158,000	467,000
November	354,000	1,035,000	442,000	660,000	211,000	498,000	321,000	313,000	582,000	1,835,000	1,301,000	791,000	778,000
December	391,000	1,067,000	793,000	955,000	372,000	1,359,000	460,000	389,000	1,056,000	1,292,000	2,590,000	1,273,000	1,177,000
Average	828,000	682,000	891,000	879,000	934,000	942,000	1,215,000	834,000	902,000	1,257,000	1,629,000	1,092,000	1,087,000
Average, driest six months	201,000	327,000	210,000	318,000	208,000	666,000	432,000	320,000	412,000	752,000	878,000	468,000	543,000

[1] The area of the watershed used in making up these records included water surfaces amounting to 2.2 per cent of the whole area from 1897 to 1902, inclusive, 2.4 per cent in 1903, 3.6 per cent in 1904, 4.1 per cent in 1905, 5.1 per cent in 1906, 6.0 per cent in 1907, 7.0 per cent in 1908, 1909 and 1910, 6.5 per cent in 1911, 6.8 per cent in 1912, 6.9 per cent in 1913, 7.4 per cent in 1914 and 1915, 7.6 per cent in 1916, 7.4 per cent in 1917, 7.2 per cent in 1918, and 7.5 per cent in 1919, 1920 and 1921.

TABLE No. 8. — *Yield of the Sudbury Watershed in Gallons per Day per Square Mile,*[1] *1875–1921.*

MONTH.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.
January	103,000	643,000	658,000	1,810,000	700,000	1,120,000	415,000	1,241,000	335,000	995,000	1,235,000	1,461,000
February	1,496,000	1,368,000	949,000	2,465,000	1,711,000	1,787,000	1,546,000	2,403,000	1,033,000	2,842,000	1,354,000	4,801,000
March	1,604,000	4,435,000	4,814,000	3,507,000	2,330,000	1,374,000	4,004,000	2,839,000	1,611,000	3,785,000	1,572,000	2,059,000
April	3,049,000	3,292,000	2,394,000	1,626,000	3,116,000	1,169,000	1,546,000	867,000	1,350,000	2,853,000	1,815,000	1,947,000
May	1,188,000	1,138,000	1,391,000	1,394,000	1,114,000	514,000	965,000	1,292,000	937,000	1,030,000	1,336,000	720,000
June	870,000	222,000	597,000	506,000	413,000	175,000	1,338,000	529,000	300,000	416,000	426,000	203,000
July	321,000	183,000	202,000	128,000	157,000	176,000	276,000	86,000	115,000	224,000	62,000	116,000
August	396,000	405,000	121,000	476,000	395,000	119,000	148,000	55,000	79,000	257,000	240,000	94,000
September	207,000	184,000	60,000	161,000	141,000	80,000	197,000	307,000	91,000	44,000	121,000	117,000
October	646,000	234,000	631,000	516,000	71,000	102,000	186,000	299,000	186,000	83,000	336,000	146,000
November	1,302,000	1,088,000	1,418,000	1,693,000	206,000	205,000	395,000	209,000	205,000	175,000	1,177,000	673,000
December	584,000	453,000	1,290,000	3,177,000	463,000	175,000	775,000	315,000	194,000	925,000	1,174,000	1,020,000
Average	972,000	1,135,000	1,214,000	1,452,000	894,000	578,000	979,000	862,000	533,000	1,129,000	901,000	1,087,000
Average, driest six months	574,000	384,000	502,000	532,000	230,000	143,000	330,000	211,000	145,000	200,000	391,000	223,000

[1] See note at end of this table.

TABLE No. 8. — *Yield of the Sudbury Watershed in Gallons per Day per Square Mile,*[1] *1875–1921* — Continued.

MONTH.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.
January	2,589,000	1,053,000	2,782,000	1,254,000	3,018,000	1,870,000	434,000	693,000	1,034,000	1,084,000	845,000	1,638,000
February	2,829,000	1,950,000	1,196,000	1,529,000	3,486,000	943,000	1,542,000	991,000	541,000	2,676,000	1,067,000	3,022,000
March	2,868,000	3,238,000	1,338,000	3,643,000	4,453,000	1,955,000	3,245,000	2,238,000	2,410,000	3,835,000	2,565,000	2,604,000
April	2,620,000	2,645,000	1,410,000	1,875,000	2,397,000	871,000	2,125,000	1,640,000	2,515,000	1,494,000	1,515,000	1,829,000
May	1,009,000	1,632,000	880,000	1,366,000	583,000	1,259,000	2,883,000	840,000	636,000	360,000	915,000	1,246,000
June	413,000	421,000	653,000	568,000	413,000	428,000	440,000	419,000	174,000	399,000	962,000	530,000
July	115,000	117,000	634,000	107,000	149,000	214,000	158,000	161,000	231,000	95,000	658,000	231,000
August	214,000	379,000	1,432,000	132,000	163,000	280,000	181,000	209,000	229,000	57,000	591,000	1,107,000
September	111,000	1,155,000	823,000	457,000	203,000	229,000	108,000	150,000	89,000	388,000	182,000	369,000
October	190,000	1,999,000	1,230,000	2,272,000	210,000	126,000	222,000	374,000	1,379,000	592,000	94,000	1,160,000
November	369,000	2,758,000	1,941,000	1,215,000	305,000	697,000	319,000	836,000	2,777,000	659,000	909,000	1,986,000
December	643,000	3,043,000	2,241,000	996,000	544,000	485,000	796,000	716,000	1,782,000	657,000	1,584,000	1,799,000
Average	1,154,000	1,697,000	1,383,000	1,285,000	1,315,000	781,000	1,037,000	770,000	1,152,000	1,019,000	991,000	1,450,000
Average, driest six months	234,000	953,000	944,000	747,000	239,000	327,000	237,000	356,000	460,000	314,000	564,000	777,000

[1] See note at end of this table.

TABLE No. 8. — *Yield of the Sudbury Watershed in Gallons per Day per Square Mile,*[1] *1875–1921* — Continued.

MONTH.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.
January	2,288,000	794,000	437,000	1,763,000	1,736,000	477,000	1,410,000	1,128,000	1,351,000	1,925,000	392,000	1,490,000
February	1,381,000	3,800,000	300,000	1,674,000	2,279,000	882,000	330,000	1,041,000	624,000	1,536,000	2,286,000	1,849,000
March	4,205,000	3,654,000	2,755,000	4,199,000	3,454,000	2,999,000	2,497,000	2,409,000	1,658,000	2,257,000	1,734,000	1,954,000
April	2,521,000	1,350,000	4,204,000	1,885,000	2,261,000	3,294,000	1,643,000	1,949,000	1,607,000	1,117,000	1,721,000	667,000
May	511,000	1,312,000	2,954,000	743,000	351,000	1,745,000	297,000	1,059,000	888,000	1,046,000	1,004,000	277,000
June	66,000	316,000	753,000	303,000	1,987,000	419,000	467,000	707,000	761,000	194,000	239,000	516,000
July	19,000	—18,000	306,000	66,000	445,000	62,000	177,000	398,000	9,000	—14,000	—121,000	—102,000
August	—35,000	—34,000	424,000	135,000	307,000	170,000	114,000	180,000	—104,000	102,000	—45,000	—73,000
September	94,000	65,000	305,000	178,000	130,000	397,000	1,246,000	19,000	541,000	—82,000	149,000	5,000
October	115,000	186,000	412,000	506,000	492,000	191,000	158,000	301,000	741,000	47,000	—51,000	—51,000
November	304,000	663,000	474,000	444,000	363,000	289,000	279,000	483,000	1,998,000	71,000	82,000	176,000
December	220,000	1,096,000	2,695,000	1,779,000	582,000	269,000	887,000	659,000	2,032,000	136,000	263,000	221,000
Average	973,000	1,082,000	1,342,000	1,140,000	1,190,000	931,000	795,000	860,000	1,010,000	694,000	625,000	570,000
Average, driest six months	93,000	194,000	445,000	271,000	388,000	228,000	403,000	341,000	471,000	44,000	40,000	29,000

[1] See note at end of this table.

TABLE NO. 8. — *Yield of the Sudbury Watershed in Gallons per Day per Square Mile,*[1] *1875–1921* — Concluded.

MONTH.	1911.	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1920.	1921.	Mean for 47 Years, 1875–1921.
January	519,000	728,000	1,041,000	908,000	1,629,000	942,000	510,000	273,000	1,306,000	312,000	976,000	1,135,000
February	700,000	1,197,000	754,000	1,009,000	1,870,000	1,356,000	755,000	1,809,000	917,000	743,000	845,000	1,605,000
March	1,144,000	3,092,000	2,090,000	3,029,000	593,000	1,820,000	2,209,000	2,187,000	2,759,000	5,192,000	2,270,000	2,733,000
April	1,426,000	2,235,000	2,232,000	2,353,000	590,000	3,037,000	1,405,000	1,466,000	1,713,000	2,911,000	1,144,000	1,972,000
May	318,000	1,447,000	867,000	1,550,000	255,000	1,439,000	1,476,000	639,000	1,290,000	1,846,000	1,658,000	1,098,000
June	213,000	148,000	149,000	5,000	101,000	1,198,000	1,044,000	185,000	112,000	1,696,000	171,000	501,000
July	—14,000	—77,000	—62,000	107,000	1,045,000	585,000	43,000	96,000	299,000	284,000	1,021,000	201,000
August	20,000	—29,000	—54,000	156,000	1,168,000	78,000	202,000	—54,000	92,000	—39,000	59,000	223,000
September	76,000	—28,000	88,000	—135,000	38,000	26,000	58,000	637,000	713,000	64,000	—58,000	223,000
October	296,000	—14,000	484,000	—59,000	231,000	—5,000	482,000	274,000	279,000	—26,000	—98,000	387,000
November	593,000	165,000	480,000	97,000	261,000	110,000	438,000	489,000	1,275,000	669,000	667,000	732,000
December	908,000	494,000	732,000	250,000	898,000	315,000	380,000	938,000	1,095,000	1,200,000	1,195,000	959,000
Average	514,000	779,000	733,000	772,000	719,000	904,000	750,000	736,000	988,000	1,239,000	824,000	978,000
Average, driest six months	151,000	26,000	180,000	29,000	480,000	186,000	267,000	269,000	458,000	360,000	294,000	376,000

[1] The area of the Sudbury watershed used in these records included water surfaces amounting to 1.9 per cent of the whole area from 1875 to 1878, inclusive, and was subsequently increased by the construction of storage reservoirs, to 3.0 per cent in 1879, 3.4 per cent in 1885, 3.9 per cent in 1894, and 6.5 per cent in 1898. The watershed also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of water surfaces.

NOTE. — Since 1897 the reservoirs on the Sudbury watershed have been full of water nearly all the time, while large quantities of water have been received from the Wachusett Reservoir and the recorded yield has been affected by these conditions, especially during dry weather.

TABLE No. 9. — *Wachusett System. — Statistics of Flow of Water, Storage and Rainfall in 1921.*

[Watershed above dam = 108.84 square miles.]

MONTH.	GALLONS PER DAY.							Rainfall (Inches).	Rainfall collected (Inches).	Percentage of Rainfall collected.
	Received from City of Worcester Watershed.	Discharged into Wachusett Aqueduct.[1]	Wasted into River below Dam.	Seepage through the North Dike.[2]	STORAGE.[3] Gain.	STORAGE.[3] Loss.	Total Yield of Watershed.			
January	10,680,000	163,577,000	64,468,000	980,000	–	74,945,000	153,816,000	2.67	2.521	94.3
February	–	155,686,000	31,136,000	939,000	–	71,643,000	116,118,000	4.07	1.719	42.2
March	20,990,000	99,945,000	1,590,000	968,000	191,278,000	–	273,165,000	2.87	4.477	156.1
April	11,386,000	142,512,000	15,661,000	1,001,000	24,544,000	–	210,205,000	6.51	3.329	51.1
May	15,977,000	94,100,000	32,277,000	1,000,000	–	2,690,000	225,423,000	3.01	3.695	123.0
June	–	133,213,000	1,680,000	993,000	–	84,573,000	52,230,000	3.75	0.828	22.1
July	4,907,000	79,306,000	1,697,000	1,000,000	33,910,000	–	111,103,000	6.41	1.821	28.4
August	2,345,000	115,813,000	1,693,000	977,000	–	89,432,000	26,716,000	1.94	0.438	22.6
September	–	120,358,000	1,701,000	939,000	–	110,605,000	12,393,000	2.35	0.197	8.4
October	–	127,555,000	8,158,000	903,000	–	119,371,000	17,245,000	2.00	0.282	14.1
November	–	70,423,000	1,677,000	870,000	13,157,000	–	86,127,000	7.31	1.366	18.7
December	–	87,677,000	7,568,000	881,000	42,419,000	–	138,545,000	2.77	2.271	82.1
Total	–	–	–	–	–	–	–	45.66	22.944	–
Average for year	5,597,000	115,509,000	14,065,000	954,000	–	20,054,000	118,899,000	–	–	50.3

[1] Including 209,000 gallons per day drawn from aqueduct for the supply of the Westborough State Hospital.

[2] Estimated.

[3] Aggregate storage in Wachusett Reservoir and in ponds and mill reservoirs.

TABLE No. 10. — *Sudbury System. — Statistics of Flow of Water, Storage and Rainfall in 1921.*

[Watershed=75.2 square miles.]

MONTH.	GALLONS PER DAY.									Rainfall (Inches).	Rainfall collected (Inches).	Percentage of Rainfall collected.
	Water received from Wachusett Reservoir.[1]	Water discharged through Sudbury Aqueduct.	Water discharged through Weston Aqueduct.	Water used by Framingham Water Works.	Water diverted from Watershed by Sewers, etc.	Water wasted into River below Lowest Dam.	STORAGE. Gain.	STORAGE. Loss.	Total Yield of Watershed.			
January	163,348,000	77,377,000	43,097,000	1,213,000	1,555,000	115,051,000	–	1,522,000	73,423,000	2.78	1.742	62.7
February	155,464,000	71,729,000	45,057,000	1,239,000	1,221,000	94,404,000	5,339,000	–	63,525,000	4.10	1.361	33.2
March	99,713,000	58,929,000	48,916,000	932,000	1,968,000	163,600,000	–	4,132,000	170,726,000	2.72	4.050	148.8
April	142,286,000	59,927,000	46,365,000	908,000	1,289,000	82,929,000	36,918,000	–	86,050,000	5.30	1.973	37.2
May	93,871,000	65,510,000	40,939,000	922,000	1,784,000	124,613,000	–	15,223,000	124,674,000	3.23	2.957	91.6
June	132,993,000	78,670,000	41,457,000	1,040,000	760,000	77,306,000	16,640,000	–	12,880,000	3.82	0.295	7.7
July	79,074,000	68,413,000	41,100,000	1,010,000	980,000	40,100,000	4,284,000	–	76,813,000	6.86	1.822	26.6
August	115,616,000	72,752,000	43,484,000	1,003,000	716,000	9,948,000	–	7,861,000	4,426,000	1.20	0.105	8.7
September	120,158,000	72,828,000	45,090,000	1,045,000	599,000	1,847,000	–	5,578,000	—4,327,000	1.88	—0.099	—5.3
October	127,365,000	68,110,000	44,690,000	1,032,000	652,000	2,423,000	3,097,000	–	—7,361,000	1.12	—0.175	—15.6
November	70,267,000	59,457,000	47,023,000	977,000	913,000	20,243,000	–	8,176,000	50,170,000	7.95	1.152	14.5
December	87,500,000	66,787,000[2]	47,058,000	1,032,000	1,842,000	81,765,000	–	21,090,000	89,894,000	2.54	2.132	53.8
Total	–	–	–	–	–	–	–	–	–	43.50	17.315	–
Av. for year	115,299,000	68,355,000	44,513,000	1,028,000	1,193,000	62,135,000	71,000	–	61,696,000	–	–	39.8

[1] Not including 209,000 gallons per day drawn from the Wachusett Aqueduct for the supply of the Westborough State Hospital, which were not discharged into Sudbury Reservoir.

[2] Includes 129,000 gallons per day wasted.

TABLE No. 11. — *Cochituate System. — Statistics of Flow of Water, Storage and Rainfall in 1921.*

[Watershed of lake=17.58 square miles.[1]]

MONTH.	GALLONS PER DAY.						Rainfall (Inches).	Rainfall collected (Inches).	Percentage of Rainfall collected.
	Water discharged through Cochituate Aqueduct.	Water diverted from Watershed by Sewers, etc.	Water wasted at Outlet of Lake.	STORAGE. Gain.	STORAGE. Loss.	Total Yield of Watershed.			
January	–	1,261,000	23,848,000	–	1,932,000	23,177,000	2.75	2.352	85.5
February	–	947,000	17,343,000	739,000	–	19,029,000	3.58	1.744	48.7
March	–	2,145,000	33,848,000	2,610,000	–	38,603,000	2.87	3.917	136.5
April	–	1,526,000	12,514,000	8,909,000	–	22,949,000	5.85	2.251	38.5
May	–	2,039,000	28,694,000	–	381,000	30,352,000	3.31	3.080	93.0
June	–	823,000	2,497,000	3,080,000	–	6,400,000	4.13	0.628	15.2
July	–	1,387,000	24,603,000	–	1,758,000	24,232,000	7.92	2.459	31.1
August	–	894,000	8,390,000	–	3,729,000	5,555,000	1.27	0.563	44.4
September	–	573,000	–	1,408,000	–	1,981,000	2.24	0.195	8.7
October	–	587,000	–	381,000	–	968,000	1.13	0.098	8.7
November	–	737,000	8,760,000	3,943,000	–	13,440,000	7.75	1.320	17.0
December	–	1,236,000	26,890,000	–	8,432,000	19,694,000	2.51	1.998	79.6
Total	–	–	–	–	–	–	45.31	20.605	–
Average for year	–	1,184,000	15,706,000	357,000	–	17,247,000	–	–	45.5

[1] Not including the watersheds of Dudley and Dug ponds.

TABLE No. 12. — *Elevations of Water Surfaces of Reservoirs above Boston City Base at the Beginning of Each Month.*

DATE.	Chestnut Hill Reservoir. Ordinary High Water =134.00.	Lake Cochituate. High Water =144.36.	Farm Pond. High Water =159.25.	Spot Pond. High Water =163.00.	Weston Reservoir. High Water =200.00.	FRAMINGHAM RESERVOIR. No. 1. Flash Boards 169.32.	No. 2. Flash Boards 177.12.	No. 3. Flash Boards 186.50.	Ashland Reservoir. Flash Boards 225.23.	Sudbury Reservoir. Flash Boards 259.97.	Hopkinton Reservoir. Flash Boards 305.00.	Whitehall Reservoir. Ordinary High Water =337.91.	Wachusett Reservoir. Ordinary High Water =395.00.
Jan. 1, 1921 .	133.61	142.48	159.03	162.97	199.87	167.83	176.09	186.04	224.44	257.73	304.13	336.43	393.75
Feb. 1, 1921 .	133.64	142.22	159.21	162.91	198.27	168.02	176.03	185.04	224.43	257.86	304.09	336.22	392.02
Mar. 1, 1921 .	133.79	142.31	159.46	163.29	198.45	168.30	176.37	186.41	223.71	258.16	302.89	336.23	390.43
April 1, 1921 .	133.49	142.66	159.49	162.80	199.44	168.10	176.14	185.34	223.44	257.97	303.24	336.46	394.93
May 1, 1921 .	133.95	143.80	159.62	163.17	200.11	168.20	176.46	186.48	224.80	259.69	304.49	337.12	395.42
June 1, 1921 .	133.68	143.75	159.66	163.04	197.96	167.81	176.11	183.99	224.48	259.27	304.17	336.97	395.49
July 1, 1921 .	133.88	144.14	159.29	162.99	199.97	168.83	177.33	185.83	224.76	259.88	304.25	336.96	393.63
Aug. 1, 1921 .	133.84	143.91	159.56	163.47	198.41	169.58	177.39	184.53	225.27	259.67	305.20	337.91	394.42
Sept. 1, 1921 .	133.53	143.42	159.07	163.32	199.71	169.31	177.12	186.09	225.28	259.02	304.95	337.75	392.46
Oct. 1, 1921 .	133.48	143.60	158.72	162.94	200.02	169.37	177.14	184.78	225.23	259.04	304.73	337.55	390.02
Nov. 1, 1921 .	133.58	143.65	158.39	162.77	199.07	169.33	177.13	185.26	225.15	259.35	304.47	337.39	387.13
Dec. 1, 1921 .	133.81	144.15	158.90	162.98	199.07	169.46	177.49	183.83	225.23	258.70	305.09	337.63	387.29
Jan. 1, 1922 .	133.73	143.04	159.03	162.72	200.05	167.79	176.08	184.67	224.43	257.84	304.10	336.94	388.21

TABLE No. 13. — *Sources from which and Periods during which Water has been drawn for the Supply of the Metropolitan Water District.*

From Wachusett Reservoir into the Wachusett Aqueduct.

MONTH.	Number of Days during which Water was flowing.	ACTUAL TIME.		Milion Gallons drawn.
		Hours.	Minutes.	
January	25	497	25	5,070.9
February	23	384	30	4,359.2
March	27	272	–	3,098.3
April	25	356	30	4,269.4
May	25	296	45	2,917.1
June	26	307	21	3,996.4
July	22	217	55	2,458.5
August	27	338	45	3,590.2
September	25	341	50	3,615.8
October	25	359	15	3,954.2
November	25	291	50	2,112.7
December	24	232	45	2,718.0
Totals	299	162.37 days		42,160.7

From Sudbury Reservoir through the Weston Aqueduct to Weston Reservoir.

MONTH.	Number of Days during which Water was flowing.	ACTUAL TIME.		Million Gallons drawn.
		Hours.	Minutes.	
January	25	560	14	1,336.0
February	23	461	3	1,261.6
March	27	418	55	1,516.4
April	25	425	30	1,389.0
May	25	381	15	1,269.1
June	26	334	16	1,243.7
July	25	366	54	1,274.1
August	27	359	20	1,348.0
September	25	397	6	1,354.6
October	25	353	28	1,385.4
November	24	377	30	1,410.7
December	26	410	59	1,458.8
Totals	303	201.94 days		16,247.4

TABLE No. 13. — *Concluded.*

From Framingham Reservoir No. 3 through the Sudbury Aqueduct to Chestnut Hill Reservoir.

MONTH.	Number of Days during which Water was flowing.	Actual Time (Hours).	Million Gallons drawn.
January	31	744	2,398.7
February	28	672	2,008.4
March	31	744	1,826.8
April	30	719	1,795.3
May	31	744	2,030.8
June	30	720	2,360.1
July	31	744	2,120.8
August	31	744	2,255.3
September	30	721	2,187.9
October	31	744	2,111.4
November	30	720	1,783.7
December	31	735	2,066.4
Totals	365	364.63 days	24,945.6

TABLE No. 14. — *Average Daily Quantity of Water flowing through Aqueducts in 1921, by Months.*[1]

MONTH.	Wachusett Aqueduct into Sudbury Reservoir (Gallons).	Weston Aqueduct into Metropolitan District (Gallons).	Sudbury Aqueduct into Chestnut Hill Reservoir (Gallons).	Cochituate Aqueduct into Chestnut Hill Reservoir (Gallons).
January	163,348,000	43,097,000	77,377,000	–
February	155,464,000	45,057,000	71,729,000	–
March	99,713,000	48,916,000	58,929,000	–
April	142,286,000	46,365,000	59,927,000	–
May	93,871,000	40,939,000	65,510,000	–
June	132,993,000	41,457,000	78,670,000	–
July	79,074,000	41,100,000	68,413,000	–
August	115,616,000	43,484,000	72,752,000	–
September	120,158,000	45,090,000	72,828,000	–
October	127,365,000	44,690,000	68,110,000	–
November	70,267,000	47,023,000	59,457,000	–
December	119,758,000	47,058,000	66,658,000	–
Average	118,039,000	44,513,000	68,344,000	–

[1] Not including quantities wasted while cleaning and repairing aqueducts.

TABLE No. 15. — (*Meter Basis.*) *Average Daily Consumption of Water by Districts in the Cities and Towns supplied by the Metropolitan Water Works in 1921.* (*For Consumption of Water in Whole Metropolitan Water District, see Table No. 17.*)

Month.	Southern Low Service. Boston, excluding East Boston and Charlestown (Gallons).	Northern Low Service. Portions of Charlestown, Somerville, Chelsea, Everett, Malden, Medford, East Boston and Arlington (Gallons).	Southern High Service. Quincy, Watertown, and Portions of Boston, Belmont and Milton (Gallons).	Northern High Service. Revere, Winthrop, Swampscott, Nahant, Stoneham, Melrose, and Portions of Boston, Chelsea, Everett, Malden, Medford and Somerville (Gallons).	Southern Extra High Service. Portions of Boston and Milton (Gallons).	Northern Extra High Service. Lexington and Portions of Arlington and Belmont (Gallons).	Total District supplied (Gallons).	Estimated Population.	Consumption per Inhabitant (Gallons).
January	44,262,200	26,248,300	45,915,000	8,826,300	716,000	836,600	126,804,400	1,226,590	103
February	41,715,400	24,628,300	44,038,500	8,546,100	691,000	846,500	120,465,800	1,228,780	98
March	39,776,800	23,720,300	42,183,500	8,341,000	707,900	880,200	115,609,700	1,230,970	94
April	36,789,200	22,898,300	40,796,800	8,300,800	731,800	899,100	110,416,000	1,233,170	90
May	37,751,800	24,307,500	41,578,900	8,827,200	758,400	942,100	114,165,900	1,235,360	92
June	38,502,000	26,239,800	44,019,100	11,089,900	976,600	1,405,300	122,232,700	1,237,550	99
July	37,772,700	25,038,600	42,323,200	10,092,500	786,800	966,900	116,980,700	1,239,740	94
August	37,491,000	25,264,700	42,910,000	10,371,600	769,400	1,084,200	117,890,900	1,241,930	95
September	38,250,100	25,518,900	44,054,900	10,355,900	818,300	1,100,500	120,098,600	1,244,130	97
October	37,667,700	24,234,300	42,212,300	9,521,600	804,300	1,031,400	115,471,600	1,246,320	93
November	36,665,000	24,046,700	39,976,200	8,694,500	771,100	911,800	111,065,300	1,248,510	89
December	39,714,500	25,876,000	41,822,300	8,696,400	751,400	935,300	117,795,900	1,250,710	94
For the year	38,854,100	24,838,400	42,646,100	9,308,400	773,600	986,800	117,407,400	1,239,740	95

In addition to the above quantities the United States Government Reservation on Peddock's Island was supplied with 22,066,000 gallons, equivalent to a daily average rate of 60,500 gallons, and a part of Saugus with 12,008,000 gallons, equivalent to a daily average rate of 32,900 gallons.

TABLE No. 16. — (*Meter Basis.*) *Average Daily Consumption of Water in Cities and Towns supplied by the Metropolitan Water Works in 1921.*

City or town	ARLINGTON.		BELMONT.		BOSTON.		CHELSEA.		EVERETT.		LEXINGTON.		MALDEN.	
Population	19,210.		11,390.		766,800.		44,180.		41,290.		6,540.		50,350.	
MONTH.	GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.	
	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.
January	977,300	51	570,700	51	95,351,300	126	3,116,400	71	3,728,500	91	381,000	59	2,597,000	52
February	962,000	51	584,300	52	90,261,600	119	3,031,000	69	3,576,700	87	380,300	59	2,327,800	47
March	939,500	49	590,900	53	85,982,500	113	2,983,900	68	3,562,600	87	407,800	63	2,288,000	46
April	952,200	50	602,500	54	81,027,400	106	2,843,200	65	3,358,300	82	405,800	62	2,283,200	46
May	1,026,700	54	667,000	59	83,352,700	109	2,962,900	67	3,427,100	83	425,400	65	2,372,500	47
June	1,653,700	86	1,113,900	98	86,077,600	112	3,192,200	72	3,682,000	89	586,300	90	2,723,200	54
July	1,075,100	56	685,300	60	84,318,300	110	3,092,400	70	3,394,800	82	443,900	68	2,496,400	50
August	1,220,300	63	724,800	63	84,176,600	109	3,160,300	71	3,570,400	86	485,400	74	2,488,500	49
September	1,315,000	68	795,200	69	86,252,700	112	3,293,300	74	3,567,100	86	486,200	74	2,583,200	51
October	1,117,300	58	628,100	55	83,653,500	109	3,151,300	71	3,562,500	86	455,000	69	2,585,400	51
November	948,700	49	597,800	52	80,675,400	105	3,042,300	68	3,386,000	81	424,400	64	2,441,500	48
December	1,017,200	52	582,700	50	86,360,500	111	3,338,500	75	3,551,900	85	417,500	63	2,428,900	48
For the year	1,100,300	57	678,300	60	85,609,200	112	3,101,300	70	3,530,600	86	441,700	68	2,468,700	49

TABLE No. 16. — *Average Daily Consumption of Water in Cities and Towns, etc.* — Continued.

City or town	MEDFORD.		MELROSE.		MILTON.		NAHANT.		QUINCY.		REVERE.	
Population	41,130.		18,550.		9,550.		1,380.		49,460.		30,340.	
MONTH.	GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.	
	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.
January	1,727,500	43	1,012,300	55	394,500	42	117,400	87	4,208,600	86	1,820,000	61
February	1,635,600	40	942,200	51	394,500	42	129,700	95	4,135,400	85	1,823,600	61
March	1,663,700	41	948,700	51	400,200	42	95,300	70	4,053,300	83	1,657,500	55
April	1,728,600	42	990,500	54	402,900	42	106,600	78	4,045,300	82	1,675,100	56
May	1,846,500	45	1,055,500	57	403,700	42	151,400	111	4,202,300	85	1,820,500	60
June	2,088,200	51	1,332,300	72	470,800	49	372,500	270	4,667,100	95	2,226,300	74
July	1,856,700	45	1,118,200	60	373,900	39	288,000	209	4,456,200	90	2,226,800	73
August	2,011,300	49	1,094,900	59	350,100	37	317,200	230	4,468,600	90	2,391,100	79
September	1,922,900	46	1,144,400	62	406,800	42	303,700	218	4,432,000	89	2,248,100	74
October	1,845,500	44	1,051,400	56	428,900	45	143,200	103	4,261,000	86	1,990,300	65
November	1,956,200	47	1,021,000	55	414,300	43	80,300	57	4,033,900	81	1,742,500	57
December	1,952,600	47	1,060,100	57	391,600	41	78,600	56	4,260,200	85	1,869,900	61
For the year	1,853,900	45	1,064,700	57	402,500	42	182,100	132	4,269,500	86	1,958,600	65

TABLE No. 16. — *Average Daily Consumption of Water in Cities and Towns, etc.* — Concluded.

City or Town	SOMERVILLE.		STONEHAM.		SWAMPSCOTT.		WATERTOWN.		WINTHROP.		METROPOLITAN DISTRICT.	
Population	95,310.		7,980.		8,350.		21,800.		16,120.		1,239,740.	
MONTH.	GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.	
	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.
January	7,272,500	77	675,900	85	577,200	70	1,475,000	68	801,300	51	126,804,400	103
February	6,881,800	73	660,700	83	563,900	68	1,391,700	64	783,000	49	120,465,800	98
March	6,625,400	70	621,000	78	555,000	67	1,446,400	67	788,000	49	115,609,700	94
April	6,390,700	67	623,800	78	546,900	66	1,651,900	76	781,100	49	110,416,000	90
May	6,590,000	69	585,800	74	662,900	80	1,809,500	83	803,500	50	114,165,900	92
June	7,507,700	79	668,500	84	1,054,100	127	1,784,400	82	1,031,900	64	122,232,700	99
July	6,999,800	73	633,800	79	874,500	105	1,601,900	73	1,044,700	65	116,980,700	94
August	6,971,300	73	647,400	81	950,300	114	1,828,300	84	1,034,100	64	117,890,900	95
September	7,141,200	75	611,500	77	904,500	108	1,753,500	80	937,300	58	120,098,600	97
October	6,847,600	72	600,500	75	772,000	92	1,542,700	71	835,400	51	115,471,600	93
November	6,746,600	70	520,500	65	660,900	78	1,555,500	71	817,500	50	111,065,300	89
December	7,057,700	73	480,100	60	498,100	59	1,638,200	75	811,600	50	117,795,900	94
For the year	6,919,400	73	610,400	76	718,800	86	1,624,400	75	873,000	54	117,407,400	95

TABLE No. 17. — *Consumption of Water in the Metropolitan Water District, as constituted in the Year 1921, and a Small Section of the Town of Saugus, 1893–1921.*

[Gallons per Day.]

MONTH.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
January	75,209,000	67,506,000	68,925,000	82,946,000	85,366,000	83,880,000	96,442,000	100,055,000	111,275,000
February	71,900,000	68,944,000	80,375,000	87,021,000	83,967,000	87,475,000	103,454,000	98,945,000	117,497,000
March	67,638,000	62,710,000	69,543,000	86,111,000	82,751,000	85,468,000	90,200,000	97,753,000	105,509,000
April	62,309,000	57,715,000	62,909,000	77,529,000	79,914,000	76,574,000	86,491,000	89,497,000	93,317,000
May	61,025,000	60,676,000	65,194,000	73,402,000	76,772,000	76,677,000	89,448,000	87,780,000	95,567,000
June	63,374,000	68,329,000	69,905,000	77,639,000	77,952,000	83,463,000	97,691,000	98,581,000	103,420,000
July	69,343,000	73,642,000	69,667,000	80,000,000	85,525,000	88,228,000	96,821,000	107,786,000	106,905,000
August	66,983,000	67,995,000	72,233,000	78,537,000	84,103,000	87,558,000	92,072,000	102,717,000	102,815,000
September	64,654,000	67,137,000	73,724,000	74,160,000	84,296,000	88,296,000	91,478,000	103,612,000	102,103,000
October	63,770,000	62,735,000	67,028,000	71,762,000	79,551,000	81,770,000	89,580,000	98,358,000	103,389,000
November	61,204,000	62,231,000	64,881,000	71,933,000	72,762,000	78,177,000	86,719,000	93,648,000	101,324,000
December	66,700,000	65,108,000	70,443,000	79,449,000	76,594,000	86,355,000	85,840,000	97,844,000	113,268,000
Average	66,165,000	65,382,000	69,499,000	78,360,000	80,793,000	83,651,000	92,111,000	98,059,000	104,645,000
Population	724,180	744,720	765,430	787,880	810,340	832,790	855,250	877,700	892,740
Per capita	91.4	87.8	90.8	99.5	99.7	100.4	107.7	111.7	117.2

See note at end of this table.

TABLE No. 17. — *Consumption of Water, etc.* — Continued.

[Gallons per Day.]

MONTH.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.
January	118,435,000	125,176,000	137,771,000	130,878,000	126,093,000	137,730,000	132,376,000	133,275,000	127,568,000	123,281,000
February	117,268,000	122,728,000	143,222,000	140,595,000	130,766,000	150,822,000	146,199,000	130,763,000	131,093,000	124,359,000
March	108,461,000	111,977,000	123,334,000	120,879,000	123,570,000	134,202,000	128,884,000	126,842,000	117,078,000	116,669,000
April	103,153,000	107,179,000	108,688,000	111,898,000	118,428,000	121,556,000	128,926,000	125,335,000	112,775,000	111,656,000
May	106,692,000	111,589,000	111,715,000	115,804,000	122,404,000	123,502,000	131,040,000	123,305,000	112,073,000	118,095,000
June	110,002,000	105,590,000	111,209,000	117,441,000	121,882,000	125,623,000	139,843,000	125,179,000	114,082,000	114,145,000
July	108,340,000	107,562,000	113,584,000	124,769,000	118,726,000	128,779,000	138,232,000	126,765,000	122,743,000	123,052,000
August	107,045,000	103,570,000	112,836,000	121,158,000	120,591,000	131,098,000	128,073,000	121,781,000	118,373,000	111,091,000
September	107,752,000	106,772,000	114,188,000	120,103,000	121,685,000	124,751,000	129,972,000	118,043,000	112,434,000	108,726,000
October	106,560,000	103,602,000	108,290,000	118,301,000	116,561,000	124,051,000	124,189,000	115,939,000	112,332,000	106,873,000
November	105,175,000	103,477,000	108,054,000	116,693,000	113,746,000	119,627,000	117,119,000	111,664,000	107,528,000	105,373,000
December	125,434,000	114,721,000	125,119,000	122,696,000	130,995,000	122,407,000	124,468,000	115,733,000	121,994,000	104,592,000
Average	110,345,000	110,277,000	118,114,000	121,671,000	122,085,000	128,561,000	130,712,000	122,851,000	117,458,000	113,951,000
Population	907,780	922,820	937,860	955,920	981,720	1,007,520	1,025,890	1,051,420	1,077,090	1,103,290
Per capita	121.6	119.5	125.9	127.3	124.4	127.6	127.4	116.8	109.1	103.3

See note at end of this table.

Table No. 17. — *Consumption of Water, etc.* — Concluded.

[Gallons per Day.]

Month.	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1920.	1921.
January	137,277,000	113,489,000	117,387,000	109,689,000	110,202,000	115,416,000	146,582,000	130,592,000	148,905,000	128,951,000
February	141,440,000	120,713,000	127,083,000	108,361,000	112,338,000	120,840,000	156,628,000	124,701,000	146,332,000	124,630,000
March	122,804,000	107,871,000	110,106,000	102,241,000	109,944,000	109,068,000	140,078,000	116,152,000	135,168,000	119,332,000
April	113,308,000	104,086,000	103,609,000	98,085,000	100,326,000	102,817,000	125,975,000	114,284,000	123,566,000	113,989,000
May	114,548,000	104,311,000	105,821,000	98,940,000	103,940,000	102,883,000	126,139,000	115,403,000	119,466,000	117,123,000
June	118,793,000	108,193,000	114,165,000	104,252,000	103,349,000	106,043,000	128,152,000	123,757,000	123,027,000	125,197,000
July	120,261,000	112,084,000	106,233,000	101,074,000	106,392,000	113,344,000	127,289,000	124,166,000	125,766,000	118,206,000
August	112,968,000	106,660,000	105,786,000	101,331,000	110,090,000	114,870,000	128,642,000	119,613,000	125,433,000	118,706,000
September	112,352,000	105,449,000	109,873,000	108,043,000	108,691,000	109,467,000	125,352,000	123,748,000	122,091,000	120,673,000
October	110,220,000	103,756,000	105,241,000	103,622,000	108,008,000	107,104,000	121,798,000	122,186,000	121,473,000	117,183,000
November	109,289,000	101,441,000	101,228,000	101,474,000	103,835,000	103,892,000	119,242,000	119,978,000	117,496,000	112,181,000
December	110,114,000	102,480,000	108,741,000	102,074,000	106,777,000	120,326,000	122,502,000	132,150,000	118,516,000	120,382,000
Average	118,546,000	107,466,000	109,489,000	103,227,000	106,994,000	110,475,000	130,551,000	122,227,000	127,228,000	119,691,000
Population	1,129,500	1,155,710	1,181,920	1,204,300	1,215,160	1,226,020	1,236,880	1,247,750	1,259,920	1,286,860
Per capita	105.0	93.0	92.6	85.7	88.0	90.1	105.5	97.9	101.0	93.0

This table includes the water consumed in the cities and towns enumerated in Table No. 16, together with the water consumed in Newton, which is included in the Metropolitan Water District but has not been supplied from the Metropolitan Works, and a small section of the town of Saugus.

From 1893 to 1903, inclusive, consumption based on pumpage. Since 1903, portion of supply delivered by gravity and measured by meters.

TABLE No. 18. — *Chemical Examinations of Water from the Wachusett Reservoir, Clinton.*

[Parts per 100,000.]

Date of Collection.	Appearance.			Odor.		Residue on Evaporation.		Ammonia.				Chlorine.	Hardness.
	Turbidity.	Sediment.	Color. Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		
Jan. 4	None.	None.	.10	V. faintly vegetable.	V. faintly vegetable.	3.45	1.65	.0008	.0110	.0086	.0024	.22	1.0
Jan. 21	None.	V. slight.	.15	None.	V. faintly vegetable.	3.55	1.20	.0032	.0080	.0074	.0006	.24	0.8
Feb. 1	V. slight.	V. slight.	.13	V. faintly vegetable.	V. faintly vegetable.	3.60	1.25	.0010	.0084	–	–	.25	1.3
Feb. 15	None.	V. slight.	.14	V. faintly vegetable.	V. faintly vegetable.	3.85	1.55	.0020	.0094	.0080	.0014	.20	1.1
Mar. 8	None.	V. slight.	.12	V. faintly vegetable.	Faintly vegetable.	3.65	1.35	.0014	.0100	.0080	.0020	.24	1.3
Mar. 22	V. slight.	V. slight.	.15	V. faintly vegetable.	Faintly vegetable.	3.85	1.40	.0014	.0108	.0104	.0004	.26	1.1
Apr. 5	V. slight.	V. slight.	.13	V. faintly vegetable.	Faintly vegetable.	3.40	1.25	.0006	.0108	.0102	.0006	.20	1.4
Apr. 18	V. slight.	V. slight.	.20	V. faintly vegetable.	Faintly vegetable.	3.55	1.60	.0006	.0100	.0088	.0012	.20	1.1
May 3	V. slight.	V. slight.	.15	V. faintly vegetable.	Faintly vegetable.	3.10	1.20	.0004	.0082	.0072	.0010	.19	0.6
May 17	V. slight.	V. slight.	.15	V. faintly vegetable.	Faintly vegetable.	3.25	1.25	.0006	.0088	.0054	.0034	.21	0.8
June 7	V. slight.	V. slight.	.17	V. faintly vegetable.	Faintly vegetable.	3.50	1.70	.0006	.0094	.0080	.0014	.18	0.6
June 21	V. slight.	V. slight.	.17	V. faintly vegetable and unpleasant.	Faintly vegetable and unpleasant.	3.55	1.45	.0014	.0100	.0094	.0006	.14	1.1
July 5	V. slight.	V. slight.	.10	V. faintly vegetable.	Faintly vegetable.	4.45	1.45	.0020	.0172	.0152	.0020	.22	0.8
July 19	V. slight.	V. slight.	.12	V. faintly vegetable.	V. faintly vegetable.	3.15	1.35	.0016	.0110	.0088	.0022	.18	0.6
Aug. 9	V. slight.	V. slight.	.15	V. faintly vegetable.	Faintly vegetable.	3.60	1.45	.0006	.0118	.0112	.0006	.26	1.0
Aug. 23	V. slight.	V. slight.	.10	V. faintly vegetable.	Faintly vegetable.	2.45	1.05	.0002	.0120	.0110	.0010	.26	1.1
Sept. 6	V. slight.	V. slight.	.14	V. faintly vegetable.	V. faintly vegetable.	3.00	1.00	.0006	.0084	.0082	.0002	.23	1.3
Sept. 20	V. slight.	V. slight.	.11	V. faintly vegetable.	Faintly vegetable.	3.25	1.25	.0004	.0100	.0096	.0004	.23	1.0
Oct. 4	V. slight.	None.	.10	V. faintly vegetable.	Faintly vegetable.	3.50	1.00	.0006	.0098	.0086	.0012	.14	0.8
Oct. 18	V. slight.	V. slight.	.12	V. faintly vegetable.	Faintly vegetable.	3.50	1.25	.0006	.0098	.0066	.0032	.20	0.8
Nov. 1	V. slight.	None.	.12	V. faintly vegetable.	V. faintly vegetable.	3.40	1.25	.0020	.0102	.0084	.0018	.16	1.0
Nov. 15	V. slight.	V. slight.	.10	V. faintly vegetable.	V. faintly vegetable.	3.40	1.35	.0010	.0090	.0084	.0006	.21	1.3
Dec. 9	None.	V. slight.	.10	V. faintly vegetable.	V. faintly vegetable.	3.65	1.50	.0006	.0082	.0062	.0020	.30	1.1
Dec. 20	None.	V. slight.	.10	V. faintly vegetable.	Faintly vegetable.	3.70	1.50	.0006	.0096	.0082	.0014	.24	1.3
Av.	.....	.....	.13	.....	.....	3.47	1.34	.0010	.0101	.0088	.0014	.22	1.0

TABLE No. 19. — *Chemical Examinations of Water from the Sudbury Reservoir.*

[Parts per 100,000.]

Date of Collection.	Appearance.			Odor.		Residue on Evaporation.		Ammonia.				Chlorine.	Hardness.
	Turbidity.	Sediment.	Color. Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		
Jan. 4	V. slight.	V. slight.	.16	V. faintly vegetable.	Faintly vegetable.	4.15	1.60	.0018	.0120	.0102	.0018	.30	1.4
Feb. 1	V. slight.	V. slight.	.15	V. faintly vegetable.	Faintly vegetable.	4.25	1.55	.0008	.0096	.0080	.0016	.29	1.4
Mar. 8	V. slight.	V. slight.	.15	V. faintly vegetable.	Faintly vegetable.	3.65	1.65	.0006	.0094	.0076	.0018	.25	1.6
Apr. 5	V. slight.	V. slight.	.17	V. faintly vegetable.	Faintly vegetable.	3.70	1.25	.0010	.0142	.0118	.0024	.20	1.7
May 3	V. slight.	V. slight.	.16	V. faintly vegetable.	Faintly vegetable.	4.70	2.10	.0006	.0116	.0104	.0012	.20	1.7
June 7	V. slight.	V. slight.	.19	V. faintly vegetable.	Faintly vegetable.	3.95	1.65	.0018	.0184	.0134	.0050	.26	1.3
July 8	V. slight.	None.	.13	V. faintly vegetable and earthy.	Faintly vegetable and earthy.	5.10	2.15	.0030	.0112	.0096	.0016	.26	1.1
Aug. 8	V. slight.	V. slight.	.16	Faintly unpleasant.	Distinctly unpleasant.	4.20	1.85	.0014	.0134	.0110	.0024	.27	1.1
Sept. 8	V. slight.	V. slight.	.11	V. faintly vegetable.	Faintly vegetable.	3.75	1.50	.0010	.0144	.0124	.0020	.22	1.7
Oct. 4	V. slight.	V. slight.	.12	V. faintly vegetable.	Faintly vegetable.	3.95	1.60	.0020	.0140	.0112	.0028	.28	1.0
Nov. 1	V. slight.	V. slight.	.10	Faintly vegetable.	Faintly vegetable.	2.70	1.55	.0008	.0114	.0092	.0022	.20	1.1
Dec. 13	V. slight.	V. slight.	.10	Faintly vegetable.	Distinctly vegetable.	3.50	1.25	.0010	.0098	.0088	.0010	.30	1.1
Av.	.....	.....	.14	.....	.....	4.05	1.64	.0013	.0125	.0103	.0022	.25	1.4

TABLE No. 20. — *Chemical Examinations of Water from Spot Pond, Stoneham.*

[Parts per 100,000.]

Date of Collection.	Appearance.			Odor.		Residue on Evaporation.		Ammonia.				Chlorine.	Hardness.
	Turbidity.	Sediment.	Color. Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		
Jan. 3	V. slight.	Slight.	.05	V. faintly unpleasant.	Faintly fishy.	3.90	1.70	.0020	.0176	.0120	.0056	.22	1.6
Feb. 7	V. slight.	V. slight.	.10	V. faintly cucumber.	Distinctly cucumber.	3.55	1.20	.0020	.0160	.0112	.0048	.30	1.7
Mar. 7	V. slight.	None.	.11	V. faintly vegetable.	Faintly vegetable.	4.40	2.20	.0028	.0130	.0106	.0024	.33	1.3
Apr. 11	None.	V. slight.	.05	V. faintly vegetable.	Faintly vegetable.	4.00	1.65	.0008	.0156	.0118	.0038	.30	1.1
Aug. 8	V. slight.	V. slight.	.09	V. faintly vegetable.	V. faintly vegetable.	2.90	1.00	.0004	.0094	.0086	.0008	.34	0.8
Sept. 12	V. slight.	V. slight.	.10	V. faintly vegetable.	Faintly vegetable.	3.50	1.10	.0006	.0128	.0112	.0016	.32	1.4
Oct. 10	V. slight.	Slight.	.11	V. faintly vegetable.	Faintly vegetable.	3.55	1.55	.0010	.0132	.0118	.0014	.32	1.1
Nov. 7	V. slight.	V. slight.	.05	V. faintly vegetable.	Faintly vegetable.	4.25	1.40	.0004	.0114	.0108	.0006	.28	1.4
Av.	.....	.....	.08	.....	.....	3.76	1.48	.0013	.0136	.0110	.0026	.30	1.3

TABLE No. 21. — *Chemical Examinations of Water from Lake Cochituate.*

[Parts per 100,000.]

Date of Collection.	Appearance.			Odor.		Residue on Evaporation.		Ammonia.				Chlorine.	Hardness.
	Turbidity.	Sediment.	Color. Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		
Jan. 3	V. slight.	V. slight.	.14	Faintly vegetable and earthy.	Distinctly vegetable and earthy.	6.60	2.90	.0030	.0202	.0184	.0018	.56	2.5
Feb. 1	V. slight.	Slight.	.15	Faintly vegetable and earthy.	Distinctly vegetable and earthy.	6.55	1.85	.0006	.0154	.0100	.0054	.56	2.3
Mar. 7	V. slight.	Slight.	.15	Faintly vegetable and earthy.	Distinctly vegetable and earthy.	7.20	3.10	.0026	.0166	.0142	.0024	.64	2.3
Apr. 5	V. slight.	Slight.	.15	Faintly vegetable and earthy.	Distinctly vegetable and earthy.	7.45	2.20	.0010	.0242	.0158	.0084	.56	2.6
May 2	V. slight.	Slight.	.10	Faintly vegetable and earthy.	Distinctly vegetable and earthy.	6.65	2.40	.0016	.0184	.0122	.0062	.52	2.7
June 6	V. slight.	V. slight.	.15	V. faintly vegetable.	Faintly vegetable.	7.05	2.05	.0002	.0176	.0160	.0016	.60	2.5
July 6	V. slight.	V. slight.	.13	V. faintly vegetable.	Faintly vegetable.	6.95	2.25	.0002	.0192	.0148	.0044	.64	1.8
Aug. 9	V. slight.	V. slight.	.15	Faintly vegetable and marshy.	Distinctly vegetable and marshy.	6.60	2.25	.0020	.0176	.0174	.0002	.58	2.9
Sept. 6	None.	V. slight.	.13	V. faintly vegetable and unpleasant.	Faintly vegetable and unpleasant.	6.25	2.10	.0016	.0126	.0106	.0020	.54	3.0
Oct. 31	V. slight.	Slight.	.10	V. faintly vegetable.	V. faintly vegetable.	7.00	2.50	.0006	.0242	.0142	.0100	.56	2.5
Dec. 5	Slight.	Slight.	.15	Faintly vegetable and earthy.	Distinctly vegetable and earthy.	6.50	2.25	.0008	.0166	.0096	.0070	.68	2.6
Av.	.....	.....	.14	.....	.....	6.80	2.35	.0012	.0184	.0139	.0045	.59	2.5

TABLE NO. 22. — *Chemical Examinations of Water from a Tap at the State House, Boston.*

[Parts per 100,000.]

Date of Collection.	Appearance.			Odor.		Residue on Evaporation.		Ammonia.				Chlorine.	Hardness.
	Turbidity.	Sediment.	Color. Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		
Jan. 4	V. slight.	V. slight.	.10	V. faintly unpleasant and fishy.	Faintly unpleasant and fishy.	3.70	1.40	.0008	0106	.0092	.0014	.28	1.4
Feb. 2	V. slight.	V. slight.	.15	V. faintly vegetable.	V. faintly vegetable.	4.05	1.10	.0004	.0102	.0080	.0022	.21	1.4
Mar. 9	V. slight.	V. slight.	.15	V. faintly vegetable.	Faintly vegetable.	4.20	1.80	.0016	.0102	.0088	.0014	.30	1.4
Apr. 5	V. slight.	V. slight.	.10	V. faintly vegetable.	Faintly vegetable.	4.40	1.30	.0006	.0102	.0090	.0012	.26	1.8
May 3	V. slight.	V. slight.	.14	V. faintly vegetable.	Faintly vegetable.	3.70	1.70	.0004	.0100	.0084	.0016	.22	1.3
June 8	V. slight.	Slight.	.16	V. faintly vegetable.	V. faintly vegetable.	3.65	1.10	.0006	.0102	.0072	.0030	.26	1.0
July 7	V. slight.	V. slight.	.14	Faintly cucumber.	Distinctly cucumber.	3.75	1.45	.0004	.0116	.0108	.0008	.28	1.1
Aug. 10	V. slight.	V. slight.	.12	V. faintly vegetable.	Faintly vegetable.	4.00	1.50	.0004	.0116	.0110	.0006	.26	1.4
Sept. 7	V. slight.	V. slight.	.15	V. faintly vegetable.	Faintly vegetable.	3.20	1.40	.0002	.0098	.0072	0026	.23	1.6
Oct. 5	V. slight.	V. slight.	.08	Faintly vegetable.	Distinctly vegetable.	3.70	1.20	.0008	.0124	.0116	.0008	.26	1.1
Nov. 1	V. slight.	None.	.12	None.	None.	3.75	1.30	.0004	.0076	.0058	.0018	.21	1.6
Dec. 5	V. slight.	V. slight.	.11	V. faintly vegetable.	Faintly vegetable.	3.40	1.35	.0008	.0106	.0100	.0006	.27	1.1
Av.	.....	.....	.13	.....	.....	3.80	1.39	.0006	.0104	.0089	.0015	.25	1.4

TABLE No. 23. — *Averages of Chemical Examinations of Water from Various Parts of the Metropolitan Water Works in 1921.*

[Parts per 100,000.]

LOCALITY.	Samples collected.	COLOR.	RESIDUE ON EVAPORATION.		AMMONIA.				CHLORINE.	HARDNESS.
		Platinum Standard.	Total.	Loss on Ignition.	Free.	ALBUMINOID. Total.	Dissolved.	Suspended.		
Quinapoxet River, Holden	Semi-monthly	.38	4.30	1.62	.0008	.0153	.0126	.0026	.33	0.9
Stillwater River, Sterling	Semi-monthly	.32	3.98	1.52	.0008	.0121	.0104	.0017	.20	0.9
Wachusett Reservoir, West Boylston[1]	Semi-monthly	.24	3.68	1.45	.0016	.0135	.0109	.0025	.24	1.0
Wachusett Reservoir, Clinton, surface	Semi-monthly	.13	3.47	1.34	.0010	.0101	.0088	.0014	.22	1.0
Wachusett Reservoir, Clinton, bottom[2]	Semi-monthly	.13	3.60	1.43	.0011	.0091	.0079	.0011	.22	1.0
Marlborough (Walker's Brook)	Monthly	.43	19.51	5.71	.0363	.0248	.0188	.0059	2.95	6.1
Marlborough Brook filter beds, effluent[3]	Monthly	.07	14.47	–	.0009	.0086	–	–	2.23	5.3
Wachusett Aqueduct, Southborough	Monthly	.19	3.63	1.40	.0009	.0106	.0095	.0011	.22	1.1
Sudbury Reservoir, surface	Monthly	.14	4.05	1.64	.0013	.0125	.0103	.0022	.25	1.4
Sudbury Reservoir, bottom	Monthly	.14	4.00	1.49	.0024	.0109	.0099	.0013	.26	1.3
Framingham Reservoir No. 3, inlet[4]	Monthly	.15	3.79	1.46	.0018	.0114	.0097	.0017	.24	1.4
Framingham Reservoir, No. 3, near dam	Monthly	.14	3.83	1.46	.0014	.0122	.0106	.0016	.25	1.4
Hopkinton Reservoir, inlet	Monthly	.97	5.04	2.40	.0029	.0205	.0180	.0025	.32	1.3
Hopkinton Reservoir, surface	Monthly	.54	4.55	1.94	.0016	.0151	.0127	.0024	.32	1.3
Hopkinton Reservoir, bottom	Monthly	.50	4.54	1.95	.0019	.0133	.0116	.0017	.32	1.3
Ashland Reservoir, inlet	Monthly	1.25	5.85	2.93	.0017	.0235	.0194	.0026	.29	1.5
Ashland Reservoir, surface	Monthly	.58	4.55	1.94	.0017	.0163	.0143	.0020	.25	1.3
Ashland Reservoir, bottom	Monthly	.51	4.39	1.93	.0023	.0169	.0140	.0029	.26	1.3
Framingham Reservoir No. 2, inlet[4]	Monthly	.77	7.49	2.48	.0083	.0211	.0176	.0035	.87	1.8
Framingham Reservoir No. 2, near dam[4]	Monthly	.74	6.14	2.32	.0047	.0192	.0166	.0027	.58	1.6
Lake Cochituate, surface[4]	Monthly	.14	6.80	2.35	.0012	.0184	.0139	.0045	.59	2.5
Lake Cochituate, bottom[5]	Monthly	.48	7.77	2.84	.0616	.0226	.0167	.0059	.59	2.9
Weston Reservoir[4]	Monthly	.12	4.14	1.61	.0011	.0118	.0097	.0021	.27	1.2
Terminal chamber, Sudbury Aqueduct	Monthly	.14	3.91	1.57	.0012	.0115	.0097	.0018	.27	1.4
Spot Pond[5]	Monthly	.08	3.76	1.48	.0013	.0136	.0110	.0026	.30	1.3
Tap in Revere	Monthly	.06	3.77	1.40	.0006	.0103	.0092	.0011	.29	1.4
Tap at State House	Monthly	.13	3.80	1.39	.0006	.0104	.0089	.0015	.25	1.4
Tap in Quincy	Monthly	.11	3.94	1.52	.0005	.0093	.0082	.0011	.27	1.3

[1] Averages of 22 samples.
[2] Averages of 23 samples.
[3] Averages of 9 samples.
[4] Averages of 11 samples.
[5] Averages of 8 samples.

TABLE No. 24. — *Chemical Examinations of Water from a Faucet in Boston, 1892–1921.*

[Parts per 100,000.]

YEAR.	COLOR.	RESIDUE ON EVAPORATION.		AMMONIA.				CHLORINE.	OXYGEN CONSUMED.	HARDNESS.
					ALBUMINOID.					
	Platinum Standard.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.			
1892	.37	4.70	1.67	.0007	.0168	.0138	.0030	.41	–	1.9
1893	.53	4.54	1.84	.0010	.0174	.0147	.0027	.38	.60	1.8
1894	.58	4.64	1.83	.0006	.0169	.0150	.0019	.41	.63	1.7
1895	.59	4.90	2.02	.0006	.0197	.0175	.0022	.40	.69	0.7
1896	.45	4.29	1.67	.0005	.0165	.0142	.0023	.37	.56	1.4
1897	.55	4.82	1.84	.0009	.0193	.0177	.0016	.40	.64	1.6
1898	.40	4.19	1.60	.0008	.0152	.0136	.0016	.29	.44	1.4
1899	.28	3.70	1.30	.0006	.0136	.0122	.0014	.24	.35	1.1
1900	.29	3.80	1.20	.0012	.0157	.0139	.0018	.25	.38	1.3
1901	.29	4.43	1.64	.0013	.0158	.0142	.0016	.30	.42	1.7
1902	.30	3.93	1.56	.0016	.0139	.0119	.0020	.29	.40	1.3
1903	.29	3.98	1.50	.0013	.0125	.0110	.0015	.30	.39	1.5
1904	.23	3.93	1.59	.0023	.0139	.0121	.0018	.34	.37	1.5
1905	.24	3.86	1.59	.0020	.0145	.0124	.0021	.35	.35	1.4
1906	.24	3.86	1.39	.0018	.0159	.0134	.0025	.34	.36	1.3
1907	.22	3.83	1.40	.0013	.0129	.0109	.0020	.33	.32	1.3
1908	.19	3.50	1.35	.0011	.0115	.0092	.0024	.33	.26	1.2
1909	.18	3.46	1.43	.0011	.0128	.0103	.0025	.28	.25	1.3
1910	.14	3.05	1.24	.0013	.0118	.0102	.0016	.28	.22	1.1
1911	.25	4.18	1.66	.0015	.0156	.0128	.0029	.38	.33	1.4
1912	.17	3.86	1.23	.0018	.0154	.0119	.0034	.36	.29	1.7
1913	.13	3.96	1.15	.0014	.0150	.0120	.0026	.35	.26	1.5
1914	.14	4.12	1.19	.0014	.0138	.0116	.0022	.39	.25	1.4
1915	.16	3.73	1.04	.0015	.0157	.0134	.0023	.38	.25	1.4
1916	.18	4.53	1.85	.0013	.0133	.0107	.0026	.36	–	1.4
1917	.15	4.45	1.68	.0015	.0142	.0124	.0018	.33	–	1.3
1918	.18	3.89	1.45	.0019	.0154	.0128	.0026	.29	–	1.4
1919	.20	4.28	1.41	.0010	.0130	.0108	.0022	.36	–	1.5
1920	.17	4.23	1.35	.0012	.0112	.0097	.0014	.33	–	1.5
1921	.13	3.80	1.39	.0006	.0104	.0089	.0015	.25	–	1.4

TABLE No. 25. — *Microscopic Organisms in Water from Various Parts of the Metropolitan Water Works, 1898–1921.*

[Standard units per cubic centimeter; averages from weekly or biweekly observations.]

Year.	Wachusett Reservoir.		Sudbury Reservoir.		Lake Cochituate.		Framingham Reservoir No. 3.	Framingham Reservoir No. 2.	Ashland Reservoir.	Hopkinton Reservoir.	Whitehall Reservoir.
	Surface.	Bottom.	Surface.	Bottom.	Surface.	Bottom.	Surface.	Mid-depth.	Surface.	Surface.	Surface.
1898	–	–	354	149	830	696	390	245	263	944	690
1899	–	–	470	252	905	644	440	218	357	715	393
1900	–	–	498	361	1,758	1,071	645	365	390	980	437
1901	–	–	337	225	992	702	336	149	244	450	705
1902	–	–	590	402	1,071	730	627	204	550	588	198
1903	–	–	549	388	931	795	459	169	323	231	327
1904	313	–	517	376	663	542	475	174	153	106	375
1905	769	592	644	502	1,255	503	535	158	289	240	147
1906	446	272	953	714	1,407	1,143	692	226	431	475	1,279
1907	425	212	513	419	1,123	1,200	413	205	378	336	961
1908	731	466	850	885	1,559	1,241	932	725	699	516	708
1909	2,151	1,937	2,474	2,513	1,142	1,198	2,372	610	603	294	445
1910	480	328	464	556	928	1,033	455	436	426	387	154
1911	649	368	990	988	1,942	2,216	1,140	378	592	457	397
1912	585	368	939	882	4,682	7,873	888	241	665	516	390
1913	449	270	553	541	4,964	7,322	560	253	414	298	494
1914	753	309	735	692	2,036	4,189	532	–	327	325	89
1915	519	356	1,005	828	1,900	3,213	701	–	450	284	625
1916	922	550	930	992	2,708	1,949	837	–	425	347	148
1917	296	240	658	589	1,670	2,216	663	–	–	–	–
1918	229	132	475	332	3,492	2,800	455	–	–	–	–
1919	380	352	482	527	3,673	2,878	406	–	–	–	–
1920	248	143	293	297	1,545	1,715	257	–	–	–	–
1921	284	158	410	347	2,102	2,673	382	–	–	–	–

See note at end of this table.

TABLE No. 25. — *Microscopic Organisms in Water, etc.* — Concluded.

[Standard units per cubic centimeter; averages from weekly or biweekly observations.]

YEAR.	WESTON RESERVOIR.	SPOT POND.	CHESTNUT HILL RESERVOIR.			TAPS.			
			SUDBURY AQUEDUCT.	COCHITUATE AQUEDUCT.	EFFLUENT GATE-HOUSE.	Southern Low Service.	Southern High Service.	Northern Low Service.	Northern High Service.
	Surface.	Surface.	Inlet.	Inlet.	No. 2.				
1898	–	485	304	544	304	230	–	–	–
1899	–	1,129	359	992	329	192	201	–	–
1900	–	573	568	1,139	897	468	452	–	–
1901	–	628	344	697	413	243	280	–	–
1902	–	581	563	937	525	367	451	–	–
1903	–	650	450	860	435	286	398	–	–
1904	–	465	405	838	472	303	470	274	189
1905	–	609	551	904	554	528	671	363	388
1906	783	671	631	1,042	721	550	583	326	422
1907	443	590	349	909	419	312	427	205	422
1908	979	741	783	1,073	689	666	695	443	481
1909	2,399	1,079	1,999	632	1,899	1,913	1,959	1,313	677
1910	625	622	457	–	465	447	421	221	374
1911	934	748	700	1,382	954	778	735	349	461
1912	1,117	716	855	3,887	919	1,035	967	412	462
1913	565	607	535	2,622	850	531	410	237	356
1914	757	648	492	–	540	603	549	249	412
1915	725	656	643	–	601	597	631	262	419
1916	857	811	842	–	1,041	872	858	409	520
1917	570	446	598	638	717	569	534	352	294
1918	415	347	417	2,766	521	390	485	251	217
1919	481	456	419	4,747	515	417	446	197	331
1920	282	299	253	1,638	344	230	283	138	166
1921	445	406	421	–	427	305	346	171	214

NOTE. — A large growth of Asterionella originated in the Waehusett Reservoir in 1909, causing a large number of organisms in the water of Sudbury Reservoir and Framingham Reservoir No. 3, Weston and Chestnut Hill reservoirs, Spot Pond and in the water drawn from taps.

TABLE No. 26. — *Number of Bacteria per Cubic Centimeter in Water from Various Parts of the Metropolitan Water Works, 1898–1921.*

[Averages of weekly determinations.]

YEAR.	CHESTNUT HILL RESERVOIR.			SOUTHERN SERVICE TAPS.	
	Sudbury Aqueduct Terminal Chamber.	Cochituate Aqueduct.	Effluent Gate-house No. 2.	Low Service, 180 Boylston Street.	High Service, 1 Ashburton Place.
1898	207	145	111	96	–
1899	224	104	217	117	123
1900	248	113	256	188	181
1901	225	149	169	162	168
1902	203	168	121	164	246
1903	76	120	96	126	243
1904	347	172	220	176	355
1905	495	396	489	231	442
1906	231	145	246	154	261
1907	147	246	118	130	176
1908	162	138	137	136	148
1909	198	229	119	150	195
1910	216	–	180	178	213
1911	205	204	151	175	197
1912	429	450	227	249	259
1913	123	243	157	119	140
1914	288	–	252	174	220
1915	163	–	128	117	134
1916	128	–	85	102	105
1917	178	112	119	119	141
1918	1,163	168	705	317	544
1919	92	85	100	70	84
1920	148	86	108	113	112
1921	103	–	83	92	92

TABLE No. 27. — *Colors of Water from Various Parts of the Metropolitan Water Works in 1921. (Averages of Weekly Determinations.)*

[Platinum Standard.]

MONTH.	WACHUSETT RESERVOIR.						SUDBURY RESERVOIR.				FRAMINGHAM RESERVOIR No. 3.	LAKE COCHITUATE.			CHESTNUT HILL RESERVOIR.			SPOT POND.	FELLS RESERVOIR.	NORTHERN SERVICE.		SOUTHERN SERVICE.	
	Surface.	Mid-depth.	Bottom.	Worcester Street Bridge.	Quinapoxet River.	Stillwater River.	Surface.	Mid-depth.	Bottom.	End of Open Channel.	Mid-depth.	Surface.	Mid-depth.	Bottom.	Inlet (Sudbury Aqueduct).	Inlet (Cochituate Aqueduct).	Effluent Gate-house No. 2.	Mid-depth.	Effluent Gate-house.	Tap at Glenwood Yard, Medford (Low Service).	Tap at Fire Station, Hancock Street, Everett (High Service).	Tap at 180 Boylston Street, Boston (Low Service).	Tap at 1 Ashburton Place, Boston (High Service).
January	16	16	16	27	33	27	17	17	17	16	17	19	20	27	17	–	16	10	10	16	10	16	16
February	16	16	16	26	27	24	17	17	17	17	17	17	18	42	17	–	16	11	11	17	11	17	17
March	16	16	16	28	34	29	19	19	19	21	20	21	21	22	18	–	17	11	11	17	11	17	17
April	17	17	16	27	38	33	20	20	19	20	19	19	19	20	19	–	18	12	11	18	11	19	19
May	20	22	19	46	54	48	24	24	24	47	26	21	23	33	23	–	21	11	12	21	11	21	22
June	19	19	20	26	40	35	21	24	23	23	22	20	21	26	21	–	20	11	11	21	11	20	20
July	14	13	15	27	54	55	15	15	16	22	16	17	16	66	17	–	15	10	10	15	10	15	15
August	13	13	14	25	41	37	16	16	16	15	15	15	16	142	15	–	14	10	10	14	10	14	14
September	12	13	13	17	27	21	14	14	15	13	14	14	18	216	14	–	13	11	10	13	10	13	13
October	11	12	12	13	31	21	12	12	13	17	14	13	13	201	12	–	11	10	10	12	10	12	12
November	11	11	11	12	34	26	12	12	12	19	12	12	12	68	12	–	11	9	9	11	9	11	11
December	11	10	11	32	40	29	11	13	11	11	12	12	12	13	13	–	12	8	7	11	8	12	12
Averages	15	15	15	26	38	32	17	17	17	20	17	17	17	73	17	–	15	10	10	16	10	16	16

TABLE No. 28. — *Temperatures of Water from Various Parts of the Metropolitan Water Works in 1921. (Averages of Weekly Determinations.)*

[The temperatures are taken at the same places and times as the samples for microscopical examination; the depth at place of observation is from high-water mark.]

[Degrees Fahrenheit.]

MONTH.	WACHUSETT[1] RESERVOIR (DEPTH AT PLACE OF OBSERVATION 107 FEET).			SUDBURY[1] RESERVOIR (DEPTH AT PLACE OF OBSERVATION 54.5 FEET).			WACHUSETT AQUEDUCT.	FRAMINGHAM[1] RESERVOIR NO. 3 (DEPTH AT PLACE OF OBSERVATION 20.5 FEET).			LAKE COCHITUATE[1] (DEPTH AT PLACE OF OBSERVATION 62.0 FEET).			CHESTNUT HILL RESERVOIR.	SPOT POND[1] (DEPTH AT PLACE OF OBSERVATION 28.0 FEET).			NORTHERN SERVICE.		SOUTHERN SERVICE.	
	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.	End of Open Channel.	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.	Effluent Gate-house No. 2.	Surface.	Mid-depth.	Bottom.	Tap at Glenwood Yard, Medford (Low Service).	Tap at Fire Station, Hancock Street, Everett (High Service).	Tap at 180 Boylston Street, Boston (Low Service).	Tap at 1 Ashburton Place, Boston (High Service).
January	33.6	34.0	34.7	34.1	35.3	36.0	34.0	34.4	34.3	34.5	35.8	35.6	37.2	36.6	35.6	35.8	36.5	39.8	39.9	37.5	37.1
February	34.0	34.7	35.0	35.1	35.5	35.8	34.0	35.8	35.8	36.0	37.1	38.1	38.9	36.9	37.5	37.8	38.5	39.3	40.0	37.8	37.6
March	39.1	38.8	40.0	41.8	42.5	42.0	38.0	45.2	44.6	46.5	42.5	42.4	42.2	44.3	42.7	43.0	45.5	42.5	43.0	44.0	44.1
April	45.3	45.7	43.4	50.8	49.5	48.8	45.0	50.7	49.8	50.8	50.4	43.6	45.9	50.8	49.5	49.3	49.8	50.4	49.5	51.3	51.4
May	54.1	50.9	49.7	57.1	54.5	54.3	51.8	57.6	56.1	57.3	57.3	49.9	46.5	57.4	56.9	52.0	58.5	56.3	56.3	57.0	57.7
June	66.7	57.4	50.3	67.2	64.2	60.8	59.2	69.3	58.1	65.5	69.8	52.0	47.0	68.0	68.5	68.3	66.3	66.2	66.8	67.8	67.8
July	72.0	57.5	54.5	74.5	68.8	65.0	59.0	75.2	72.4	70.1	75.4	52.4	47.9	72.8	73.5	73.5	70.3	71.3	71.5	72.5	72.4
August	70.8	71.7	55.5	72.0	70.5	67.8	63.5	72.1	71.4	70.9	72.8	54.2	47.1	72.1	73.1	73.0	73.0	71.0	71.4	72.9	72.9
September	70.1	68.8	54.2	69.8	69.5	64.5	58.0	70.0	70.7	68.7	69.8	53.1	47.3	71.0	71.1	71.5	69.8	69.9	70.0	71.7	72.3
October	59.4	57.5	51.7	60.8	62.8	58.3	56.5	58.8	60.6	56.2	58.6	54.3	47.2	61.0	60.6	62.3	59.0	62.6	62.1	62.1	63.0
November	58.2	48.3	45.0	45.9	46.3	47.0	44.7	43.8	46.6	41.7	46.3	47.0	46.6	47.3	46.4	46.3	47.0	50.1	48.9	48.7	49.5
December	37.3	39.3	36.3	34.5	35.0	36.5	38.0	33.7	33.3	34.6	36.5	37.1	37.4	37.1	35.5	34.3	37.0	41.0	41.1	40.1	39.6
Averages	53.4	50.4	45.9	53.6	52.9	51.4	48.5	53.9	52.8	52.7	54.4	46.5	44.3	54.6	54.2	53.9	54.3	55.0	55.0	55.3	55.5

[1] Surface temperatures are averages of weekly determinations. Mid-depth and bottom temperatures are averages of biweekly determinations.

TABLE NO. 29. — *Temperatures of the Air at Three Stations on the Metropolitan Water Works in 1921.*

[Degrees Fahrenheit.]

MONTH.	CHESTNUT HILL RESERVOIR.			FRAMINGHAM.			CLINTON.		
	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.
January	54	—4	32.4	54	—2	30.0	55	—4	28.7
February	–[1]	–[1]	–[1]	56	1	30.4	58	—4	28.5
March	81	16	48.0	83	17	46.2	76	15	42.6
April	83	25	54.2	84	30	52.9	77	26	50.3
May	92	32	59.4	91	32	58.8	87	36	52.4
June	94	43	68.6	93	44	69.0	–[1]	–[1]	–[1]
July	94	52	74.4	94	55	75.0	90	55	73.1
August	91	46	68.6	91	45	68.6	88	44	66.8
September	92	41	67.6	92	39	67.5	90	45	65.7
October	81	26	55.1	76	24	53.3	–[1]	–[1]	–[1]
November	71	22	41.6	70	23	39.2	–[1]	21	–[1]
December	58	0	31.2	56	1	29.6	–[1]	—2	–[1]
Averages for the year	–	–	–	–	–	51.7	–	–	–

[1] Thermometer out of order.

TABLE No. 30. — *Length of Metropolitan Water Works Main Lines and Connections and Number of Valves set in Same, Dec. 31, 1921.*

[Pipes are of cast iron unless otherwise noted.]

	Diameter of Pipes in Inches.															Total.
	60	48	42	40	36	30	24	20	16	14	12	10	8	6	4	
Total length owned and operated Dec. 31, 1920 (feet).	43,802	211,092	9,810	6,887	63,626	49,775	85,506	85,719	74,232	26	28,776	3,834	1,878	994	33	665,990
Gate valves in same	5	56	1	3	60	45	61	56	86	1	116	21	18	23	1	553
Air valves in same	51	125	5	5	47	22	43	51	38	–	11	1	–	–	–	399
Length laid or relaid during 1921 (feet)	–	5	–	–	11	29	13	14	53	–	468	19	12	–	–	624
Gate valves in same	–	–	–	–	–	–	1	–	2	–	5	1	1	–	–	10
Air valves in same	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	1
Length abandoned during 1921 (feet)	–	5	–	–	11	–	9	14	29	–	94	–	–	–	–	162.
Gate valves in same	–	–	–	–	–	–	–	–	1	–	3	–	–	–	–	4
Air valves in same	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	2
Length owned and operated Dec. 31, 1921 (feet).	43,802[1]	211,092	9,810	6,887	63,626	49,804[2]	85,510	85,719	74,256	26	29,150	3,853	1,890	994	33	666,452[3]
Gate valves in same	5	56	1	3	60	45	62	56	87	1	118	22	19	23	1	559
Air valves in same	51	125	5	5	47	22	43	51	38	–	10	1	–	–	–	398

[1] Includes 2,035 feet of 76-inch concrete-lined pressure tunnel; 363 feet of 76-inch mortar-lined and concrete-covered steel pipe; 21 feet of 76-inch cast-iron pipe and 85 feet of 60-inch concrete-covered steel pipe.

[2] Includes 15,512 feet of 30-inch mortar-lined and covered wrought-iron pipe.

[3] 126.22 miles.

TABLE NO. 31. — *Length of Metropolitan Water Works Hydrant, Blow off and Drain Pipes, Dec. 31, 1921.*

[All pipes are of cast iron.]

	Diameter of Pipes in Inches.								Total.
	24	20	16	12	10	8	6	4	
Total length in use Dec. 31, 1920 (feet)	352	292	3,121	6,882	176	513	3,576	1,497	16,409
Valves in same	–	–	30	109	2	9	85	45	280
Length laid or relaid in 1921 (feet)	–	–	–	–	–	–	24	84	108
Valves in same	–	–	–	–	–	–	1	1	2
Length abandoned in 1921 (feet)	–	–	–	–	–	–	–	12	12
Valves in same	–	–	–	–	–	–	–	–	–
Total length in use Dec. 31, 1921 (feet)	352	292	3,121	6,882	176	513	3,600	1,569	16,505[1]
Valves in same	–	–	30	109	2	9	86	46	282

[1] 3.13 miles.

TABLE No. 32. — *Length of Metropolitan Water Works Main Lines and Connections and Water Pipes, Four Inches in Diameter and Larger, in the Several Cities and Towns supplied by the Metropolitan Water Works, Dec. 31, 1921.*

BY WHOM OWNED.	INCHES.																	TOTALS.	
	60	48	42	40	36	30	24	20	18	16	14	12	10	8	7	6	4	Feet.	Miles.
Metropolitan Water Works	43,802	211,092	9,810	6,887	63,626	49,804	85,510	85,719	–	74,256	26	29,150	3,853	1,890	–	994	33	666,452	126.22
Arlington	–	–	–	–	–	–	–	–	–	–	–	25,208	30,408	41,153	–	155,823	14,497	267,089	50.59
Belmont	–	–	–	–	–	–	–	–	–	–	–	5,714	18,250	29,469	–	124,925	269	178,627	33.83
Boston	–	10,607	15,683	16,081	39,643	93,331	76,661	86,525	–	272,096	5,041	1,486,908	428,747	842,074	–	1,166,697	97,196	4,637,290	878.28
Chelsea	–	–	–	–	–	–	–	–	–	5,176	–	5,479	39,826	31,596	–	145,764	6,759	234,600	44.43
Everett	–	–	–	–	–	–	2,484	2,900	–	5,204	5,998	6,084	43,451	25,985	–	147,536	30,600	270,242	51.18
Lexington	–	–	–	–	–	–	–	–	–	–	–	9,820	5,011	36,433	–	126,681	27,794	205,739	38.97
Malden	–	–	–	–	–	–	–	–	–	8,891	11,115	84,380	30,353	92,792	–	226,806	51,090	505,427	95.73
Medford	–	–	–	–	–	–	–	673	–	6,775	9,598	33,478	40,019	99,473	–	173,394	26,317	389,727	73.81
Melrose	–	–	–	–	–	–	–	–	–	5,223	3,024	23,097	20,334	25,731	–	155,141	55,395	287,945	54.54
Milton	–	–	–	–	–	–	–	–	–	103	44	22,556	20,926	56,124	–	159,654	17,647	277,054	52.47
Nahant	–	–	–	–	–	–	–	–	–	–	4,000	150	11,550	4,800	–	36,800	57,218	114,518	21.69
Quincy	–	–	–	–	–	–	–	2,679	–	23,232	–	31,241	48,888	152,627	994	387,754	93,274	740,689	140.28
Revere[1]	–	–	–	–	–	–	–	–	–	23,813	6,970	28,605	29,955	35,794	–	109,735	71,759	306,631	58.07
Somerville	–	–	–	–	–	–	–	4,210	367	4,135	7,950	93,935	57,868	108,583	–	213,700	21,173	511,921	96.95
Stoneham	–	–	–	–	–	–	–	–	–	–	–	7,425	1,825	5,110	–	108,977	18,797	142,134	26.92
Swampscott	–	–	–	–	–	–	–	–	–	–	3,045	6,714	19,381	6,593	–	90,662	8,692	135,087	25.58
Watertown	–	–	–	–	–	–	–	–	–	2,991	11,877	5,959	24,064	30,286	–	135,944	11,816	222,937	42.22
Winthrop	–	–	–	–	–	–	–	–	–	–	–	4,049	24,198	36,330	–	55,483	54,788	174,848	33.12
Total feet	43,802	221,699	25,493	22,968	103,269	143,135	164,655	182,706	367	431,895	68,688	1,909,952	898,907	1,662,843	994	3,722,470	665,114	10,268,957	–
Total miles	8.30	41.99	4.83	4.35	19.56	27.11	31.18	34.60	0.07	81.80	13.01	361.73	170.25	314.93	0.19	705.01	125.97	–	1,944.

[1] Includes small portion of Saugus.

TABLE NO. 33. — *Number of Service Pipes, Meters, Per Cent of Services metered, Fire Services and Fire Hydrants in the Several Cities and Towns supplied by the Metropolitan Water Works, Dec. 31, 1921.*

CITY OR TOWN.	Services.	Meters.	Per Cent of Services Metered.	Services used for Fire Purposes only.	Fire Hydrants.
Arlington	3,424	3,424	100.00	15	529
Belmont	2,038	2,038	100.00	3	301
Boston	107,615	70,688	65.69	2,015	9,827
Chelsea	5,293	5,258	99.34	66	403
Everett	6,165	4,653	75.47	24	651
Lexington	1,412	1,399	99.08	6	232
Malden	8,529	8,275	97.02	55	599
Medford	7,092	7,092	100.00	20	740
Melrose	4,336	4,327	99.79	20	387
Milton	2,296	2,296	100.00	1	454
Nahant	773	592	76.58	–	102
Quincy	11,351	10,334	91.04	18	1,282
Revere[1]	4,965	4,088	82.30	4	326
Somerville	13,683	11,320	82.73	49	1,246
Stoneham	1,710	1,682	98.36	–	158
Swampscott	2,013	2,013	100.00	5	213
Watertown	3,551	3,551	100.00	21	437
Winthrop	3,060	3,046	99.54	5	330
Totals	189,306	146,076	77.16	2,327	18,217

[1] Includes small portion of Saugus.

TABLE No. 34. — *Elevation of the Hydraulic Grade Line, in Feet, above Boston City Base for Each Month at Stations on Metropolitan Water Works during 1921.*

1921. MONTH.	LOW SERVICE.												SOUTHERN HIGH SERVICE.					
	BOSTON ENGINE HOUSE, BULFINCH STREET.		ALLSTON ENGINE HOUSE, HARVARD STREET.		MEDFORD, NEAR MYSTIC RESERVOIR.		SOMERVILLE PUBLIC LIBRARY, HIGHLAND AVENUE.		MALDEN WATER WORKS SHOP, GREEN STREET.		*CHELSEA COURT HOUSE.		BOSTON METROPOLITAN WATER WORKS OFFICE, 1 ASHBURTON PLACE.		WATERTOWN WATER WORKS OFFICE, MAIN STREET.		BELMONT WATER WORKS SHOP, WAVERLEY STREET.	
	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.
January	153	138	178	170	167	163	166	159	167	162	165	154	243	223	263	256	259	246
February	154	147	178	170	167	163	167	160	168	163	166	154	244	224	263	255	260	245
March	155	143	177	168	166	162	166	159	167	162	166	154	245	224	263	255	260	245
April	156	141	177	168	166	163	165	160	166	162	167	156	245	223	263	254	258	242
May	154	143	179	169	168	163	166	159	167	160	167	152	245	225	262	251	257	236
June	155	141	179	174	168	164	167	160	167	162	167	154	244	224	262	247	257	219
July	154	140	179	170	168	164	167	160	167	162	167	155	245	226	262	252	259	239
August	153	138	179	171	168	164	167	160	167	163	166	155	245	225	262	252	260	236
September	154	139	179	168	168	163	167	159	167	162	166	155	247	223	261	250	259	233
October	153	139	179	169	168	163	167	159	167	161	167	154	248	225	263	254	262	244
November	152	140	178	168	168	162	166	158	166	161	166	153	250	230	262	252	258	241
December	153	138	177	169	169	166	165	158	165	159	165	153	248	231	263	252	258	241
Averages	154	141	178	170	168	163	166	159	167	162	166	154	246	225	262	252	259	239

TABLE No. 34. — *Elevation of the Hydraulic Grade Line, in Feet, above Boston City Base, etc.* — Concluded.

1921. MONTH.	SOUTHERN HIGH SERVICE — Concluded.						NORTHERN HIGH SERVICE.										NORTHERN EXTRA HIGH SERVICE.	
	MILTON WATER WORKS OFFICE, ADAMS STREET.		FORBES HILL TOWER, QUINCY.		QUINCY WATER WORKS SHOP.		SOMERVILLE PUMPING STATION, CEDAR STREET.		MALDEN CITY HALL.		REVERE WATER WORKS SHOP, BROADWAY.		LYNN ENGINE HOUSE, UNION SQUARE.		WINTHROP TOWN HALL, HERMAN STREET.		LEXINGTON TOWN HALL, MASSACHUSETTS AVENUE.	
	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.
January .	250	231	237	222	235	213	268	240	268	255	260	241	256	235	190	178	434	425
February .	251	232	238	224	237	214	269	247	269	264	261	249	258	244	191	179	435	425
March . .	253	233	239	225	238	215	268	244	269	263	261	249	258	246	191	178	434	423
April . .	253	232	239	225	238	215	269	243	269	263	259	247	257	244	191	176	432	424
May . .	251	229	240	224	238	211	269	240	269	261	259	243	253	236	191	175	433	423
June . .	247	223	239	215	236	205	267	230	267	257	254	226	230	200	188	161	424	403
July . .	246	226	237	222	234	209	267	241	267	259	254	234	236	213	188	168	429	420
August . .	245	225	238	223	233	208	264	241	266	259	254	231	232	203	189	170	428	417
September .	244	223	238	221	232	208	264	236	266	259	256	235	242	215	190	171	435	417
October .	246	225	238	222	235	211	267	237	268	261	258	242	250	233	191	175	438	419
November .	249	231	239	226	237	215	268	240	269	263	260	246	255	243	191	175	439	417
December .	246	229	236	224	232	214	268	240	269	263	260	247	259	245	192	176	434	426
Averages .	248	228	238	223	235	212	267	240	268	261	258	241	249	230	190	174	433	420

Appendix No. 3.

WATER WORKS STATISTICS FOR THE YEAR 1921.

The Metropolitan Water Works supply the Metropolitan Water District, which includes the following cities and towns: —

City or Town.	Population, Census of 1920.	Estimated Population, July 1, 1921.
Arlington	18,665	19,210
Belmont	10,749	11,390
Boston	748,060	766,800
Chelsea	43,184	44,180
Everett	40,120	41,290
Lexington	6,350	6,540
Malden	49,103	50,350
Medford	39,038	41,130
Melrose	18,204	18,550
Milton	9,382	9,560
Nahant	1,318	1,380
Newton[1]	46,054	46,840
Quincy	47,876	49,460
Revere	28,823	30,340
Somerville	93,091	95,310
Stoneham	7,873	7,980
Swampscott	8,101	8,350
Watertown	21,457	21,800
Winthrop	15,455	16,120
Total population of Metropolitan Water District	1,252,903	1,286,580
Portion of Saugus supplied by Revere	–	280

[1] No water supplied to Newton except through emergency connection.

Pumping.

Chestnut Hill Pumping Station No. 1: —

Builders of pumping machinery, Holly Manufacturing Company, Quintard Iron Works and E. P. Allis Company.

Description of coal used — Bituminous: 66.8 per cent Reliance and Melba–1. Anthracite: screenings, 33.2 per cent. Price per gross ton in bins: bituminous, $9.54 to $10.54; screenings, $6.15 to $7.55. Average price per gross ton, $9. Per cent ashes, 18.4.

Chestnut Hill Pumping Station No. 2: —

Builders of pumping machinery, Holly Manufacturing Company.

Description of coal used — Bituminous: 72.6 per cent Reliance, Melba–1, Melba Special and Sonman. Anthracite: screenings, 27.4 per cent. Price per gross ton in bins: bituminous, $8.96 to $10.04; screenings, $6.02 to $7.17. Average price per gross ton, $9.01. Per cent ashes, 17.2.

Spot Pond Station: —

Builders of pumping machinery, Geo. F. Blake Manufacturing Company and Holly Manufacturing Company.

Description of coal used — Bituminous: 57.6 per cent New River, Pocahontas, Spangler and Reitz–6. Anthracite: screenings, 42.4 per cent. Price per gross ton in bins: bituminous, $10.70 to $12.22; screenings, $5.98 to $6.56. Average price per gross ton, $8.77. Per cent ashes, 16.0.

Chestnut Hill Pumping Station No. 1.

	Engines Nos. 1 and 2.	Engine No. 3.	Engine No. 4.	Totals.
Daily pumping capacity (gallons)	16,000,000	20,000,000	30,000,000	66,000,000
Coal consumed for year (pounds)	–	–	–	4,000,166
Cost of pumping, figured on pumping station expenses.	–	–	–	$45,564 52
Total pumpage for year, corrected for slip (million gallons).	1,554.87	9.51	152.54	1,716.92
Average dynamic head (feet)	132.56	127.35	127.43	132.08
Cost per million gallons pumped	–	–	–	$26.5386
Cost per million foot gallons	–	–	–	.2009

Chestnut Hill Pumping Station No. 2.

	Engines Nos. 5, 6 and 7.	Engine No. 12.	Totals.
Daily pumping capacity (gallons)	105,000,000	40,000,000	145,000,000
Coal consumed for year (pounds)	–	–	13,294,429
Cost of pumping, figured on pumping station expenses	–	–	$127,425 96
Total pumpage for year, corrected for slip (million gallons)	10,595.77	13,329.04	23,924.81
Average dynamic head (feet)	30.16	122.61	81.67
Cost per million gallons pumped	–	–	$5.3261
Cost per million foot gallons	–	–	.0652

Spot Pond Pumping Station.

	Engines Nos. 8 and 9.
Daily pumping capacity (gallons)	30,000,000
Coal consumed for year (pounds)	3,291,578
Cost of pumping, figured on pumping station expenses	$35,933 57
Total pumpage for year, corrected for slip (million gallons)	3,155.63
Average dynamic head (feet)	133.01
Cost per million gallons pumped	$11.3871
Cost per million foot gallons	.0856

Consumption.

Estimated total population of the eighteen cities and towns supplied wholly or partially during the year 1921	1,239,740
Total consumption (gallons), meter basis	42,853,711,000 [1]
Average daily consumption (gallons), meter basis	117,407,400
Gallons per day to each inhabitant, meter basis	94.7

Distribution.

	Metropolitan Water Works.	Cities and Towns supplied by Metropolitan Water Works.
Kinds of pipe used	–[2]	–[2]
Sizes	76–4 inch.	48–4 inch.
Extensions, less length abandoned (miles)	.09	12.20
Length in use (miles)	126.22	1,944.88
Stop-gates added	6	–
Stop-gates now in use	559	–
Service pipes added	–	1,202
Service pipes now in use	–	189,254
Meters added	–	5,562
Meters now in use	–	146,037
Fire hydrants added	–	161
Fire hydrants now in use	–	18,217

[1] 68.7 per cent pumped; 31.3 per cent by gravity.
[2] Cast-iron, cement-lined wrought-iron, cement-lined steel and kalamine pipe.

Appendix No. 4.

CONTRACTS MADE AND PENDING DURING

Contracts relating to the

1.	1. Number of Contract.	2. WORK.	3. Number of Bids.	Amount of Bid. 4. Next to Lowest.	Amount of Bid. 5. Lowest.	6. Contractor.
1	1[1]	Part of Section 76, reservoir, pump well, and building foundations, also 16-inch cast-iron force main, Reading Extension, North Metropolitan System in Wakefield and Reading.	8	$70,424 00	$70,179 00[2]	Bruno & Petitti, Boston.
2	4[1]	Section 75, Reading Extension, North Metropolitan System in Stoneham and Wakefield.	8	29,588 50[2]	22,984 50	Antony Cefalo, Boston.
3	5[1]	Taking down and rebuilding portion of southerly chimney at East Boston pumping station in East Boston.	2	4,670 00	2,688 00[2]	Emil Malmstrom & Son Company, Boston.
4	6	2,700 tons of coal for Deer Island pumping station.	2	$10.59 per ton.	$9.69 per ton.[2]	Maritime Coal Company, Boston.
		3,000 tons of coal for East Boston pumping station.	2	$10.34 per ton.	$9,29 per ton.[2]	
		1,200 tons of coal for Charlestown pumping station.	2	$10.34 per ton.	$9.39 per ton.[2]	
5	8	550 tons of coal for Alewife Brook pumping station.	1	–	$10.62 and $11.07 per ton.[2]	Metropolitan Coal Company, Boston.
6	9[1]	Furnishing centrifugal pumps and motors for Reading pumping station in Reading.	7	$4,281 00	$3,798 00[2]	Starkweather & Broadhurst, Boston.

Contracts relating to the

1	145[1]	Section 101, High-level sewer, Wellesley Extension, South Metropolitan System in Dedham and Needham.	5	$90,080 00	$72,046 60[2]	Rendle-Stoddard Company, Chelsea.
2	2[1]	Section 100, High-level sewer, Wellesley Extension, South Metropolitan System in Dedham.	3	121,659 50	118,157 00[2]	Bruno & Petitti, Boston.

[1] Contract completed.

Appendix No. 4.

THE YEAR 1921 — SEWERAGE DIVISION.

North Metropolitan System.

7. Date of Contract.	8. Date of Completion of Work.	9. Prices of Principal Items of Contracts made in 1921.	10. Value of Work done Dec. 31, 1921.	
Feb. 11, 1920	Feb. 3, 1921	- - -	$66,871 42	1
Sept. 29, 1920	Feb. 23, 1921	- - -	37,677 93	2
April 12, 1921	May 19, 1921	For removing cast-iron cap at top of chimney and replacing same; for removing portion of lightning rod and replacing same; and for removing the brickwork of existing chimney and furnishing materials and rebuilding the chimney, the lump sum of $2,688.	3,080 59	3
April 14, 1921	-	$9.69 per ton of 2,240 pounds delivered in bins at Deer Island pumping station. $9.29 per ton of 2,240 pounds delivered in bins at East Boston pumping station. $9.39 per ton of 2,240 pounds delivered in bins at Charlestown pumping station.	54,441 75	4
April 14, 1921	-	$10.62 per ton of 2,240 pounds delivered in bins before Sept. 1, 1921; and $11.07 per ton of 2,240 pounds delivered in bins between Sept. 1, 1921, and April 1, 1922, at Alewife Brook pumping station.	3,014 84	5
May 21, 1921	Dec. 29, 1921	For furnishing complete for erection one 10-inch centrifugal pump with actuating motor of 100 h. p. capacity; and one 8-inch centrifugal pump with actuating motor of 75 h. p. capacity.	3,798 00	6

South Metropolitan System.

Sept. 17, 1919	July 25, 1921	- - -	$73,796 51	1
May 19, 1920	June 16, 1921	- - -	121,331 50	2

[2] Contract based upon this bi d.

CONTRACTS MADE AND PENDING DURING

Contracts relating to the

	1. Number of Contract.	2. WORK.	3. Number of Bids.	AMOUNT OF BID. 4. Next to Lowest.	5. Lowest.	6. Contractor.
3	3[1]	Part of Section 99, High-level sewer, Wellesley Extension in Dedham.	3	$96,300 00	$88,237 50[2]	Rendle-Stoddard Company, Chelsea.
4	6	450 tons of coal for Nut Island screen-house.	2	$10.59 per ton.	$9.37 per ton.[2]	Maritime Coal Company, Boston.
5	7	600 tons of coal for Quincy pumping station.	2	$11 per ton.	$10.82 per ton.[2]	City Fuel Company, Boston.
6	8	2,600 tons of coal for Ward Street pumping station.	2	$10.82 per ton.	$10.51 and $10.95 per ton.[2]	Metropolitan Coal Company, Boston.

[1] Contract completed.

THE YEAR 1921 — SEWERAGE DIVISION — *Continued.*

South Metropolitan System — Concluded.

7. Date of Contract.	8. Date of Completion of Work.	9. Prices of Principal Items of Contracts made in 1921.	10. Value of Work done Dec. 31, 1921.	
May 29, 1920	Feb. 7, 1921	– – –	$88,820 97	3
April 14, 1921	–	$9.37 per ton of 2,240 pounds delivered in bins at Nut Island screen-house.	3,636 00	4
April 14, 1921	–	$10.82 per ton of 2,240 pounds delivered in bins at Quincy pumping station.	6,449 29	5
April 14, 1921	–	$10.51 per ton of 2,240 pounds delivered in bins before Nov. 1, 1921; and $10.95 per ton of 2,240 pounds delivered in bins between Nov. 1, 1921, and April 1, 1922, at Ward Street pumping station.	16,053 69	6

[2] Contract based upon this bid.

CONTRACTS MADE AND PENDING DURING THE YEAR 1921 — SEWERAGE DIVISION — *Concluded.*

Summary of Contracts.

	Value of Work done Dec. 31, 1921.
North Metropolitan System, 6 contracts	$168,884 53
South Metropolitan System, 6 contracts	310,087 96
Total of 12 contracts made and pending during the year 1921	$478,972 49

Appendix No. 5.

FINANCIAL STATEMENT PRESENTED TO THE GENERAL COURT ON JANUARY 10, 1921.

The Metropolitan District Commissioner respectfully presents the following abstract of the account of the receipts, expenditures, disbursements, assets and liabilities of the Metropolitan Water and Sewerage Works for the year ending November 30, 1921, in accordance with the provisions of section 100 of chapter 92 of the General Laws.

Metropolitan Water Works.

Construction.

The loans authorized for expenditures under the Metropolitan Water acts, the receipts which are added to the loan fund, the expenditures for the construction and acquisition of works, and the balance available on December 1, 1921, have been as follows: —

Loans authorized under Metropolitan Water acts, including appropriations under St. 1920, c. 530, to provide for the reinforcement of the low-service and the northern high-service pipe lines, the construction of a reservoir in Arlington for the northern extra high service, to provide additional pumping machinery for the northern high service at Spot Pond and the southern high service at Chestnut Hill pumping stations		$45,685,000 00
Receipt from town of Swampscott for admission to Metropolitan Water District, paid into loan fund (St. 1909, c. 320)		90,000 00
Receipts from the sales of property which are placed to the credit of the Metropolitan Water Loan Fund:		
For the year ending November 30, 1921	$7,217 59	
For the period prior to December 1, 1920	264,616 13	
		271,833 72
		$46,046,833 72

Amount approved for payment from the Metropolitan Water Loan Fund:		
For the year ending November 30, 1921	$126,806 79	
For the period prior to December 1, 1920	43,286,759 39	
		$43,413,566 18
Balance December 1, 1921		$2,633,267 54

The amount of the Metropolitan Water Loan bonds issued at the end of the fiscal year was $42,947,000, no bonds having been issued during the year. Of the total amount issued, $41,398,000 were sinking fund bonds, and the remainder, amounting to $1,549,000, were issued as serial bonds.

At the end of the year the amount of outstanding bonds was $42,682,000, as bonds issued on the serial payment plan to the amount of $265,000 had been paid. During the fiscal year $44,000 in serial bonds has been paid.

The Metropolitan Water Loan Sinking Fund amounted on December 1, 1921, to $18,147,014.21, an increase during the year of $1,193,849.06.

Maintenance.

Amount appropriated for the maintenance and operation of works for the year ending November 30, 1921	$867,960 00	
Receipts credited to this fund for the year ending November 30, 1921	4,165 94	
		$872,125 94
Amount approved for maintenance and operation of works during the year ending November 30, 1921	$777,817 52	
Deduct amount paid from appropriation for the year 1920	35,061 02	
		743,756 50
Balance December 1, 1921		$129,369 44

The Commission has also received during the year ending November 30, 1921, $108,996.23 from rentals, the sale of land, land products and power and from other proceeds from the operations of the Metropolitan Water Works, which, according to section 18 of the Metropolitan Water Act, are applied by the Treasurer of the Commonwealth to the payment of interest on the Metropolitan Water Loan, to sinking fund requirements and expenses of maintenance and operation of works, in reduction of the amount to be assessed upon the Metropolitan Water District for the year.

Sums received from sales of water to municipalities not belonging to the District and to water companies, and from municipalities for admission to the District, have been applied as follows: —

For the period prior to December 1, 1906, distributed to the cities and towns of the District, as provided by section 3 of the Metropolitan Water Act	$219,865 65
For the period beginning December 1, 1906, and prior to December 1, 1920, applied to the Metropolitan Water Loan Sinking Fund, as provided by chapter 238 of the Acts of 1907	106,275 39
For the year beginning December 1, 1920, and ending November 30, 1921, applied to the Metropolitan Water Loan Sinking Fund, as provided by said last-named act	9,359 48
	$335,500 52

Metropolitan Sewerage Works.

Construction.

The loans authorized under the various acts of the Legislature for the construction of the Metropolitan Sewerage Works, the receipts which are added to the proceeds of the loans, and the expenditures for construction are given below, as follows: —

North Metropolitan System.

Loans authorized for expenditures for construction under the various acts, including those for the Revere, Belmont and Malden extensions, North System enlargements and extensions, new Mystic sewer, Deer Island outfall extension, lowering sewer siphon under Malden River, balance of appropriation under chapter 76, Resolves of 1915, and for the Reading extension	$7,512,365 73	
Receipts from sales of real estate and from miscellaneous sources, which are placed to the credit of the North Metropolitan System:		
For the year ending November 30, 1921	419 45	
For the period prior to December 1, 1920	87,002 71	
		$7,599,787 89
Amount approved for payment from the Metropolitan Sewerage Loan Fund, North System:		
For the year ending November 30, 1921	$39,311 82	
For the period prior to December 1, 1920	7,533,268 29	
		7,572,580 11
Balance December 1, 1921		$27,207 78

South Metropolitan System.

Loans authorized for expenditures for construction under the various acts, applied to the construction of the Charles River valley sewer, Neponset valley sewer, high-level sewer and extensions (including Wellesley Branch), and an additional appropriation authorized by St. 1920, c. 525, and for additional Ward Street station pumping plant	$9,912,046 27	
Receipts for pumping, sales of real estate and from miscellaneous sources, which are placed to the credit of the South Metropolitan System:		
For the year ending November 30, 1921 .	4,756 35	
For the period prior to December 1, 1920 .	19,881 05	
		$9,936,683 67
Amount approved for payment from the Metropolitan Sewerage Loan Fund, South System:		
On account of the Charles River valley sewer .	$800,046 27	
On account of the Neponset valley sewer . .	911,531 46	
On account of the high-level sewer and extensions:		
For the year ending November 30, 1921 .	149,138 92	
For the period prior to December 1, 1920 .	8,039,151 29	
		9,899,867 94
Balance December 1, 1921		$36,815 73

The amount of the Metropolitan Sewerage Loan bonds issued at the end of the fiscal year was $17,311,412, no bonds having been issued during the year. Of the total amount issued, $15,440,912 were sinking fund bonds, and the remainder, amounting to $1,870,500, were serial bonds.

At the end of the year the amount of the outstanding bonds was $17,013,412, as bonds issued on the serial payment plan to the amount of $53,500 had been paid during the year, $298,000 having been paid to December 1, 1921.

Of the total amount outstanding at the end of the year, $7,307,500 were issued for the North Metropolitan System, and $9,705,912 for the South Metropolitan System. The Metropolitan Sewerage Loan Sinking Fund amounted on December 1, 1921, to $5,698,228.38, of which $3,534,016.07 was on account of the North Metropolitan System, and $2,164,212.31 was on account of the South Metropolitan System, an increase during the year of $529,704.35.

The net debt on December 1, 1921, was $11,315,183.62, a decrease of $583,204.35.

Included in the above figures for the North Metropolitan System is $925,500 in serial bonds, of which $181,000 has been paid, and $945,000 for the South Metropolitan System, of which $117,000 has been paid.

Maintenance.

North Metropolitan System.

Appropriated for the year ending November 30, 1921		$319,845 00
Receipts from pumping and from other sources, which are returned to the appropriation:		
For the year ending November 30, 1921		527 01
		$320,372 01
Amount approved for maintenance and operation of Metropolitan Sewerage Works, North System:		
For the year ending November 30, 1921	$308,199 18	
Deduct amount paid from appropriation for the year 1920	25,519 77	
		282,679 41
Balance December 1, 1921		$37,692 60
Appropriated, Item 635, chapter 203, Acts of 1921, for the construction of Reading extension pumping station		$40,000 00
Amount approved for payment to November 30, 1921		33,844 56
Balance December 1, 1921		$6,155 44

South Metropolitan System.

Appropriated for the year ending November 30, 1921		$194,650 00
Receipts from sales of property, reimbursement and for pumping, which are returned to the appropriation:		
For the year ending November 30, 1921		547 73
		$195,197 73
Amount approved for maintenance and operation of Metropolitan Sewerage Works, South System:		
For the year ending November 30, 1921	$188,711 44	
Deduct amount paid from appropriation for the year 1920	9,711 32	
		179,002 12
Balance December 1, 1921		$16,197 61